JOURNAL

OF

THE FRANKLIN INSTITUTE

OF THE STATE OF PENNSYLVANIA

FOR THE

PROMOTION OF THE MECHANIC ARTS.

NOVEMBER, 1848.

CIVIL ENGINEERING.

On the Steam Power of the Locomotive Engine.

Extract from the Report of the Railway Commissioners, on the Broad and Narrow Gauges, to the House of Lords.

The steam power of the locomotive engine may evidently be increased, as an increase of gauge permits the size of the engine to be increased; but the power can only be applied to the load through the friction between the driving wheels and the rail, or, as it is technically termed, through the adhesion. The steam machinery is employed to turn the wheels of the engine, and those wheels will revolve without progressing, if the resistance to the forward motion of the engine and train be greater than the friction between the wheels and the rails.—Whatever the steam power of the engine may be, its useful effect is limited by the adhesion. The adhesion is limited by the weight which can be given to an engine, and the proportion of that weight which can with safety be thrown upon a pair of wheels, or by the action to which the rails can be exposed; and although the rails might be made of such strength, and be so secured and laid on such a foundation as to be able to bear the rapid movement of almost any weight, still the expenses of construction and maintenance impose a practical limit; and the replies of the eminent engineers of the Great Western and London and North Western Railway Companies, to the inquiries relating to these subjects, which will be found in the sixty-ninth and following pages of the Appendix, have an important bearing on the question.

After carefully considering those replies, the Commissioners are in-

clined to believe that, when the highest rates of speed are to be used, the adhesion of one pair of driving wheels ought not, at the present time, to be estimated to exceed between 3500 and 4000 lbs.; and it appears to be fully admitted, that, when such speeds are required, the adhesion of only one pair of wheels can be employed.

If, at the required speed, the tractive power afforded by the steam machinery of a well-proportioned engine, adapted to a particular gauge, be less than this, a better engine for such speed would be obtained by increasing the gauge; but any increase of the gauge beyond the width necessary to obtain the additional steam power required, would, so far as the power of the engine is concerned, be unnecessary.

It is useless to consider to what gauge this particular view of the subject might assign a preference. It only appears necessary to inquire, whether the steam machinery of well-proportioned engines adapted to the narrow gauge can afford, at the high speeds maintained upon the broad gauge, a tractive power equivalent to the adhesion of their driving wheels; and if not, what advantage over such engines, with respect to load, an engine must possess, which can employ its full power of adhesion, at the speed assumed as the maximum upon a level line, and to what extent that advantage would be affected by different gradients.

To enable the Commissioners to arrive at some conclusion on this subject, the queries which will be found at page 43 of the Appendix, were sent to the Great Western, and the London and North Western Railway Companies, to obtain the facts which are necessary to be known, before a perfect conclusion on the above inquiry can be arrived at, and which it was hoped the experience of the engineers of those Companies would enable them to supply. A reference to the answers returned to those queries, which will be found at the 48th and following pages of the Appendix, will show the very great uncertainty which still exists on many of the points embraced in them.

Experiments similar to those which have been made by Mr. Gooch, and given with his replies, would probably, if made by different parties on different lines, afford correct data for this investigation; but it is necessary now to endeavor to form the best judgment which the present state of information will permit.

The tractive power afforded by the steam machinery of a locomotive engine, at high velocities, principally depends upon its power of evaporation, or the quantity of water it can convert into steam within a given interval; and an assumption may be made on this point with tolerable confidence; but of the deductions to be made from the whole amount of steam power created for various resistances in the machine itself, and of the resistance of trains at different velocities, it is not possible, from the replies given, to form satisfactory estimates.

From the evidence given before the Gauge Commissioners, and the experiments detailed in the Appendix to their Report, it might be supposed that about 180 cubic feet per hour is a fair estimate of the evaporative power of narrow gauge engines; but, from the replies given to the above-mentioned questions, the Commissioners believe they are justified in assuming that there are well proportioned narrow gauge engines, having an evaporating power of 200 cubic feet per hour.

An engine with this evaporative power, and having 16-inch cylinders, a stroke of 21 inches, and 6½ feet driving wheels, when cutting off the steam at ⅜ths of the stroke, may, it appears to the Commissioners, be fairly considered to have its power limited by its adhesion for all speeds under forty miles per hour. At that speed, the Commissioners believe the tractive power afforded by the steam machinery is nearly equal to the adhesion assumed at 3700 lbs., that it rapidly diminishes as the speed increases, and that the power of the engine may be thus stated at the under-mentioned velocities on a level:—

Miles per hour.	Load exclusive of engine and tender.
40	140 tons.
50	60 "
60	22 "

If the tractive power afforded by the steam machinery at sixty miles per hour, were equal to the adhesion, a load (including the weight of the engine and tender) of from 100 to 120 tons might be conveyed. The largest engines now in use on the broad gauge lines, have an evaporative power sufficient to accomplish this; and, allowing for their greater weight, it may be considered that they can draw an ordinary passenger train of sixty tons weight with as much facility, on a level, at sixty miles per hour, as the narrow gauge engines can at fifty. On moderately descending gradients, the larger engine would possess a similar degree of advantage; but in proportion as the inclinations increased, and considerations of safety imposed a limit to the speed, the advantage would diminish and disappear.

On ascending gradients, the difference between the power of the narrow and broad gauge engines varies. As the ascent increases in steepness the difference diminishes; but the inclination on which it may be considered that the two engines would have equal power, over a train of sixty tons, is dependent on the resistance of such a train at different rates of speed, respecting which a correct opinion cannot at present be formed. Adopting, however, for such resistance, a mean between the results obtained by Mr. Gooch, and those approved by Mr. Harding, in the communication made by him to the Institution of Civil Engineers, and referred to by Mr. Locke, and by Messrs. Stephenson, M'Connell, and Trevithick, in their replies, given at page 72 of the Appendix, it appears to the Commissioners that, on an ascent of 1 in 170, the two engines would have nearly the same power over a train of sixty tons, and that, on steeper gradients, the greater weight of the larger engine would cause the difference to be in favor of the smaller engine. If, however, the greater steadiness of the larger engine will allow a greater weight to be thrown, with safety, upon the driving wheels, when high speeds are to be used, than has been assumed, the difference in favor of the larger engine would diminish more slowly, and it would maintain an advantage on a gradient steeper than 1 in 170, depending on the amount of additional weight; and if the resistance of the trains on the broad gauge be less than on the narrow, as might be inferred from a comparison of the experiments above mentioned, if correct, the result would be yet more favorable to the former.

Lond. Rail. Journ., No. 475.

The Ordnance Survey of the Metropolis.

The area intended to be comprised in the metropolitan survey is something above 200 square miles,—or nearly 130,000 acres; and the map is to be constructed on the very large scale (for a district of such an extent) of 60 inches to a mile, or one inch to 88 feet,—which, when completed, will occupy about 900 sheets, three feet by two feet, or about 5400 square feet of paper or copper. The London survey will be connected, by its triangulation, with the general survey of the country, and, in its levelling, with the one uniform datum plane to which the altitudes of the Ordnance six-inch map are referred. By this means, when the map is complete, the relative levels of any two points within the eight mile radius of the metropolitan survey, or of any part of London, and any part of the north of England, may be seen at a glance by those who require, and know how to look for, the information.—*Builder.* Lond. Athen., July, 1848.

Railway Commissioners' Report on Railways.

This Report, issued on Tuesday, contains in 223 pages, articles on accidents; opening of railways; cheap trains; by-laws; exercise of powers under general Acts, and under special Acts; references under Standing Orders; Reports on Colonial Railways; statistics, returns, &c. The Appendix contains the several Reports made by the Inspectors of Railways, relating to openings, accidents, &c.

On the opening of Railways it states, that during the last two years, a very large addition has been made to the extent of railway open for traffic: at the end of 1845, it appeared that 2441 miles were available to the public; 595 miles were opened in 1846, and 780 miles in 1847, making the whole extent of railway completed at the end of 1847, 3816 miles: of which 3157 are in England; 440 in Scotland; and 219 miles in Ireland.

Between November, 1846, when the Commissioners entered upon their duties, and the end of 1847, they were called upon to direct preliminary inspections previous to openings, in 100 instances, of which 94 occurred in 1847. It 21 cases it was considered necessary by the Board to postpone the opening, either of the whole, or of a part of the railway inspected; and in 40 cases, when authorizing the opening, the Commissioners thought it necessary, for the public safety, to make suggestions respecting a temporary or permanent restriction of the speed on certain parts of the line, the arrangement of signals, points, &c. Besides the important object of providing for the public safety, the inspection required, previously to the opening of the railway, may be of public utility, by affording the means of ascertaining whether the line and works have actually been constructed in due conformity with the provisions of the Act by which they were authorized, and in several instances unauthorized deviations have thus been reported to the Commissioners. In one instance Captain Simmons, in the report of his inspection of a part of the Waterford and Kilkenny Railway, stated,

that the gradients do not accord with the Parliamentary Section, the surface of the ground, as it exists, being entirely of a different form from that delineated on the Parliamentary section.

On inquiry, it appeared that the errors in the section submitted to Parliament, on which the Company obtained their Act, are so very great, that the objects of the Legislature in calling for detailed sections, have been entirely frustrated, and no person whose property was likely to be affected by the line, could form any judgment of the manner in which his property would be interfered with. They have been informed, that no complaints have been made by landowners or others, with respect to that portion of the line which has been already executed.

Under the head of statistics, a table is given, showing the results of returns presented to Parliament, for the several annual periods for which they have been made up since 1843, showing the rapid rate at which the amount of railway transport is increasing, from which we extract the following:—

Summary of Traffic Returns on Railways in the United Kingdom.

Traffic for year end'g June 30.	Miles opened at middle of each period.	Total Number of Passengers.	Receipts for Passengers.	Receipts for Goods.	Total Receipts.	Traffic per mile per annum.
1843	1,857	23,466,896	£3,110,257	£1,424,932	£4,555,189	£2,442
1844	1,952	27,763,602	3,439,294	1,635,380	5,047,674	2,599
1845	2,148	33,791,253	3,976,341	2,233,373	6,209,714	2,891
1846	2,441	43,790,983	4,725,215	2,840,353	7,565,569	3,099
1847	3,036	51,352,163	5,148,002	3,362,884	8,510,886	2,803

The following table has been compiled from returns relating to the financial transactions of Railway Companies:—

	Length of Railway authorised to be made.	Capital authorised to be raised by Shares and Loans.	Nominal Value of Stock on Shares.	Amount actually raised.			Length opened for Traffic.
				On Shares.	By Loans.	Total.	
Prior to 31st	£	£	£	£	£	£	
Dec. 1843	2,276	82,840,082		43,468,641	22,062,151	65,530,792	1,952
During 1844	805	20,454,698		4,341,519	2,479,256	6,820,775	196
1845	2,700	59,479,485		15,622,831	506,978	16,129,809	293
1846	4,538	128,918,207		30,856,627	6,958,366	37,814,993	595
1847	1,354	44,879,739		32,173,973	8,851,514	41,025,487	780
	11.673	336,580,210	222,635,668	126,463,591	40,858,265	167,321,856	3,816

In the foregoing table, the several sums are principally derived from the returns made by the Railway Companies. It states that it may be assumed that, at the end of 1847, all the lines authorized previously to 1844 were completed; of 805 miles sanctioned in 1844, there had been 665 miles opened for public traffic, and the remainder were in progress; of 2700 miles authorized in 1845, there had been 786 com-

pleted; and of 4538 miles authorized in 1846, there had been 84 completed. From this it appeared, that, under ordinary circumstances, the railways sanctioned in one session of Parliament, are completed within 4½ years from the end of that session; that less than one-fifth of the whole require more than 3½ years for their completion; about one-half requiring between 2½ and 3½ years; and the remainder less than 2½ years. That if Railway Companies had experienced no extraordinary difficulty in raising capital during 1847, it may be estimated that their expenditure in that year, under the Acts of 1844-5-6-7, would have been £64,000,000; but that little more than £41,000,000 were raised for railway purposes in that year. And if that be assumed as the limit which their expenditure will be able to attain, it will require four years for them to obtain the capital now authorized, but not yet raised by them. And if this expenditure be maintained, and the capital authorized be sufficient for the completion of the several lines, it may be expected that about 2000 miles will be completed annually during the next four years.

We do not think it likely that this supposition will be realized, or even a moiety thereof. Lond. Rail. Journ., No. 475.

Waterloo Extension of the London and South-Western Railway.

The extension of the London and South-Western Railway from Nine Elms to Waterloo Bridge road, was opened on the 11th ultimo. It appears to us that it would have been far better if the Waterloo Station had been made on the vacant ground adjoining, north of the present Waterloo terminus, and the principal entrance in York road. The entrance to the railway would then have been as near to Westminster and Hungerford bridges as it is now to Waterloo bridge, without increasing the distance to the latter place, or the length of the railway. This alteration might now be easily made; it would save nearly half a mile, and eight minutes' walk, to foot passengers from Westminster and Charing Cross; the present approaches might be retained for a goods depôt—and if a steamboat pier were made adjoining to the Surrey approach of Hungerford bridge, and arrangements made with the steamboats to come direct from London bridge to the pier, the extension of the railway to London bridge might be abandoned, and thereby nearly a million sterling saved. This would, we are sure, enhance the value of the shares, and give confidence to those capitalists in the city who are now alarmed at the apparent reckless manner in which funds are being expended by railways on branches and extensions.

The works of this undertaking were commenced in July, 1846, by Messrs. Lee, the contractors, who engaged to complete the works by the 1st of July, 1848. Mr. Thompson acted as the superintendent to the contractors, and Mr. Curlieu on behalf of Mr. Locke, the engineer. The length of the new line is nearly 2¾ miles. The first quarter of a mile is carried over an embankment; then succeeds a viaduct, consisting of six massive iron girder bridges, and 300 arches, (exclusive of those forming the present station in the Waterloo road.) These arches,

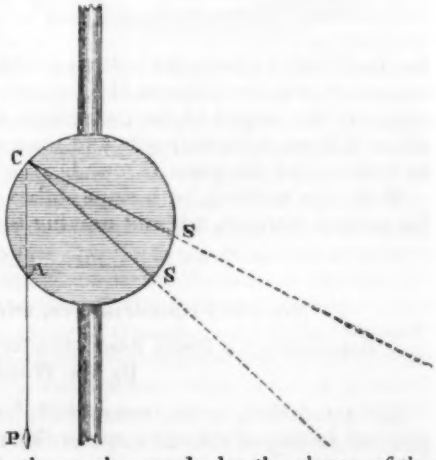
which are expected to form a very considerable item in the receipts of the company, have been so carefully constructed, as to be easily applicable to various purposes, and their perpetual dryness has been insured by the application of the Seyssel asphalte, which has rendered them impervious to wet. There are four distinct lines of rail, and the quantity of iron alone consumed in laying down what is technically called the 'metals,' is at least 1200 tons, independently of about 800 tons weight consumed in the erection of the bridges. In the construction of the viaduct and station of the Waterloo road, upwards of 80,000,000 of bricks have been consumed; and the present terminus, which is all on arches, covers a space of three-quarters of an acre of ground, its width being 260 feet. The major part of the present terminus has been coated with Claridge's asphalte, so that the arches on which it rests may with safety be made use of as storehouses, &c. To the present terminus in the Waterloo road there are no less than four approaches for carriages and foot passengers, the pedestrians having, in each approach, footpaths eight feet in width. The stations at both Waterloo road and Vauxhall are only temporary. The fares on the main line are increased as follows:—First class, 6d.; second class, 4d.; third class, 2d. The Nine Elms station is now closed entirely to passenger traffic. **Civ. Eng. & Arch. Journ., Aug., 1848.**

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Methods for Ascertaining the Side Slopes on Railroad Embankments and Cuttings.

I have seen described, within two or three years, several methods for ascertaining the side slopes of railroad embankments and cuttings, most of them, however, present objections, from which I think the following free. The method most followed in the United States, that of approximation, is tedious, particularly where the ground is rough or very undulating.

Fig. 1.

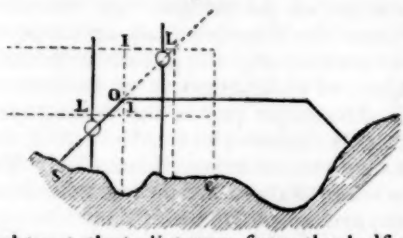


For accurate work, the disk of the level target should be from 9 to 12 inches in diameter. At one corner, if square, or at C, if round, fix into the target a fine pin, with a button on the outer end, so as to prevent from slipping off, the loop of a fine silk thread, CP or CS. With a fine edged tool, draw a straight line, CA, by which, with the plumb line, CP, the rod and target will be kept in proper position in operations. From C to S draw the line CS, which should make, with the line CA, the angles made by the slopes of the

work with a vertical line. A fine silk thread, of some thirty feet in length, should also be provided, to loop over the button at C.

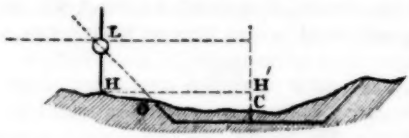
It will now be evident that, if the rod be set plumb, so that the point C shall be placed in the plane of a slope, that by extending the silk thread over the line CS, the intersection of that line with the natural surface will be a point for a slope stake.

Fig. 2.



To find the slope stake at S, having on the ground the centre stake, and the fill, set the level, and, by placing the rod on the centre C, ascertain how much the level is above or below the top of the embankment contemplated; then, if the slope is 1 to 1, and the level strikes above the embankment, a distance OI, subtract that distance from the half width of the embankment, and measure off from C the remainder, and at the point where that distance falls, set up the rod, and raise the target till the button with loop strikes the line of sight. Then extending the silk thread to the ground, along the line CS, (fig. 1,) the point is fixed. If the line of level strikes below the top of the embankment, then the line LI, added to the half width, will be the distance from the centre stake at which the rod is to be set up, and proceed, as before, to raise the target, till the button strikes the sight from the instrument. It will be evident that if the slope of the embankment runs with a different angle, say, as 1½ to 1, then the line IL must bear the same proportion to IO.

Fig. 3. *To Find the Slope Stakes of a Cut.*



Here it is evident that the instrument must be set above the surface, or that there is but one solution. The instrument being set at A, and the rod on C, the centre pin, the height of the instrument above the bottom of the cut is ascertained; then, if the slope is 1 to 1, the distance HH', equal to the half width at the bottom, added to the height of the instrument above the bottom, is measured off to H from the centre pin, and the rod set up there, the target raised as before, and the point O found.

With this method, both slope stakes may frequently be ascertained, for several stations, without moving the instrument. B.

On the Velocentimeter, with its Applications.

Read before the British Association for the Advancement of Science.

By Mr. Whishaw.

He stated that, in the year 1837, he was engaged in working the general survey of the railways in Great Britain and Ireland; and that

he invented the first velocentimeter, for the purpose of testing more readily than by the ordinary watch, furnished with a second hand, the time occupied in passing over measured distances, which were usually marked by posts or standards. He now exhibited an improved instrument, which resembled a handsome chronometer—and observed that it had tabulated thousands of miles, without being out the hundredth part of a minute. He stated that by it, with the assistance of the electric telegraph, the time of the United Kingdom could be made uniform to half a second. Lond. Athenæum, Aug. 1848.

Notice of the Death of GEORGE STEPHENSON, ESQ., *Civil Engineer.*

On the 12th instant, died Mr. George Stephenson, the author of the railway system, the first great practical improver of the locomotive steam engine, the inventor (cotemporaneously with Davy) of the safety-lamp, and a man who displayed a vigorous and original genius in everything which he undertook. He was born on the 9th of June, 1781, (was consequently, at the time of his death, in his 60th year,) at a little village near Newcastle-on-Tyne, of parents in the humblest rank of life. His first occupation as a boy, was attending to the steam engines used at the mouth of coal pits. Eventually he became a coal viewer, or surveyor and overseer; and distinguished himself in the coal district by an improved mode of carrying on some great works at Darlington. In 1812, a committee which had investigated the priority of the claims of the discoverers of the safety-lamp, gave him a public dinner at Newcastle, at which he was presented with a silver tankard, and a purse of a thousand guineas. In returning thanks, he announced his intention of devoting that sum to the education of his only son, Robert, at the University of Edinburgh. The history of his employment to construct the Stockton and Darlington, the first public railroad, and the Liverpool and Manchester, the first on which locomotive engines were introduced for the conveyance of passengers,—is well known. From the first journey of the locomotive built by the Stephensons over the railroad constructed by them, dates the actual commencement of the greatest mechanical revolution effected since the invention of the steam engine by Watt. Though self-educated,—scarcely educated at all beyond reading and writing until he had attained manhood,—Mr. Stephenson took every opportunity of impressing upon the young the advantages of science and literature. He related at a public dinner, at the opening of the Birkenhead Docks, how, in his early career, after the labors of the day, he used to work in the evening at mending watches and clocks, in order to earn enough to send his child to school. He was the founder and first president of the Society of Mechanical Engineers, and was never better pleased than when assisting by his advice and encouragement, the ideas of ingenious artizans. In agriculture and horticulture he made many curious and successful experiments,—and the study of geology was a passion with him. It is feared that the intermittent fever, of which he died, was occasioned by the damp miasma arising from the fertilizers, which he employed with

great success in his hot-houses. In a brief and hurried notice, it is impossible to do justice to so remarkable a man. In the words of a cotemporary writer: "His mechanical genius was of that order that it may, without exaggeration, be asserted that if Watt had not previously invented the steam engine, he was capable of achieving it. Others before him had prepared the way; others since have contributed valuable improvements in detail; but to George Stephenson unquestionably belongs the proud title of the Author of the Railway System. He gathered the many threads of ingenuity and enterprise, and weaved them into the wide-spreading net-work which promises, in its manifold extension, to envelope the whole world in bonds of commerce, civilization, and peace." Ibid.

On the Improvements which have been made in Steam Navigation.

Read before the British Association for the Advancement of Science.
By Mr. Scott Russell.

The first great improvement that had been made was in the boilers. Formerly, the boiler flues were constructed of great length, so that the smoke was kept winding round and round in the flues, and at last was allowed to escape with difficulty. Now, however, they had adopted the plan of getting as much fire as possible, in the shortest space of time,—and this had been accomplished by imitating, as nearly as they could, the locomotive engine boiler, by having tubes of thin metal, which would evaporate a much greater quantity of water in the same time as flues of the usual thickness; now, also, instead of taking the smoke a long dance, as in the old fashion, they used short flues of four to six feet in length, and by having a great many of as thin metal as possible, they heated the greatest quantity of water, and had the additional advantage of keeping the metal cool,—in consequence of which a boiler of smaller extent and surface was of much greater efficiency, with less weight of metal. The next point of improvement was in the engine, in the construction of which, however, there had been less change than in other matters. The former beam engine had been changed for the direct action engine, which was of various kinds; but the greatest change which had been made within the last ten years, consisted in the employment of greater quantities of wrought iron in the construction of the engines, instead of the mass of cast iron formerly used. This was the only great change,—for the newest Halifax steamers were still fitted up with the old-fashioned or lever engines. The next improvement consisted in working steam expansively to a much greater extent than heretofore. It was only within the last ten years that they had adopted this principle: the effect of which was, that, instead of completely filling the cylinder with steam, they filled only to the extent of one-fourth—a volume of steam not of course of equal density, but by which they got two-thirds of the work done, and at one fourth of the cost. The next improvement had been made in the paddle; not so much, perhaps, in the wheel itself—for he was still inclined in favor of the old paddle-wheel, although, for short voyages,

he admitted the advantage of the feathering paddle-wheel, which had been advocated by Mr. Price at their meeting some years ago, and he had then opposed him—but of this by-and-bye. Another great improvement which had been made, was the driving the paddle-wheels faster. They had an old maxim, which was, whereas a good old horse, going 2½ miles an hour, could not draw advantageously at more than 220 feet per minute, and that, as the steam engine was only a substitute for horses, and reckoned as so much horse power, it ought not to go faster than 2½ miles per hour—and this one thing had kept them back for half a century. He did not mean that the result should be faster than 2½ miles per hour, but that the piston should not rise up and down in the cylinder faster than 2½ miles an hour, which was only 4 feet in a second, while the motion of steam of 15 lbs. was 1100 feet in a second. Fortunately, however, this old maxim had been abandoned, and the piston now moved from 250, 270, to 300 feet in a minute. For this improvement they were indebted to no new principle, but to the application of mathematical principles of science. He now came to another great improvement, which was the change in the formation of steamboats, which had been radical—he meant the entire alteration in the form of the ships. A few years ago, steam vessels which would go ten or twelve miles an hour were deemed fast ships; now, however, we had attained a much higher rate of speed. Vessels were then built on the old-fashioned principle that the water-line should be nearly straight, and that the run of the vessel should be a fine line, and that there should never be a hollow line, except a little in the run of the ship, but that there most certainly should not be any hollow line in the bow, for there the water-lines should be straight or a little convex. Researches and inquiries were, however, made by a Committee of the British Association, as to the form which would enable the vessel to go fastest through the water. These inquiries lasted for years, and they established, by a series of experiments, a set of very curious facts. Formerly, every builder of ships had his notion of proportion; some that the length should be four times the breadth,—others that it should be 4½ or 5,—and some went as far as to say that the length should be six times the breadth, but these were deemed innovations: so that, although the proportions of width, as compared with breadth, were said to be fixed ones, yet strangely enough, every one differed as to those proportions. Another question was, what part of the vessel should have the greatest width, and it was generally thought that the greatest width should be nearest the bow. Some daring persons had, however, put it back as far as the centre of the ship. This was, however, the exception, and not the rule. Then there was another great principle, which was, that the bow and the stern should exactly balance each other,—that is, that the vessel should be equally balanced; but the new rules which the British Association had established were as follows:—They began by upsetting the old rule with respect to the proportions which the length should bear to the breadth, finding that the greater the speed required, the greater should be the length, and that the vessel should be built merely of the breadth necessary to enable the engines to be put in, and to stow the

requisite cargo. Then the second great improvement made by them was, that the greatest width of water-line, instead of being before the middle, should be abaft the middle of the vessel, and, in fact, two-fifths from the stern, and three-fifths from the bow. The next great improvement was that, instead of having the bow broad and bluff, or a cod's head bow, for the purpose of rising over the wave, you might have hollow water-lines, or what were called wave lines, from their particular form, and with that form the vessel would be propelled with less power and greater velocity,—and also, that instead of keeping to the old fine run abaft, and cutting it away, you might, with great advantage, have a fuller line abaft, provided it was fine under the water. Thus, by these improvements, the form of the old vessel was pretty nearly reversed, to the great annoyance of the old school, and the steamers were given large and commodious cabins and after holds, instead of having cabins so pinched in that you could hardly stand in them. Another heresy, introduced by the British Association, was that of the principle as to the balance of the stern and the bow upon which they now rested; but which was founded in a most singular error, for they left out something which was very material. They concluded that the wave acted equally on both ends of the vessel in striking it; but they did not take into consideration the impossibility of this when a vessel was moving, not having taken into calculation the velocity of the wave, or of the vessel, and that from this circumstance, the concussion from a wave striking the bow would be a most powerful one, while it could not be so with regard to the stern, because if the velocity of the wave meeting it was fifteen miles, the shock would be as of thirty miles; and, therefore, it became most plain that the bow would give the greatest resistance to the wave. He had examined all the fastest steamers which had accomplished fifteen to seventeen miles an hour—and in smooth water eighteen miles an hour; and he would venture to state that there was not one of them, which accomplished from fifteen to seventeen miles an hour, which had not all these alterations in every particular, and that the wave form and wave principle were now adopted by all the great steamship builders, and that all the fast steamboats had what was called the wave bow. Now, of the eight boats on the Holyhead and Dublin stations, if examined, it would be found that all of them were built on these principles, although in some of them there was still left a little of the old principle, some of the boats being made a little fuller and more straight; and if any one would look at one of these boats, it would be perceived that the moment they moved, the very wave itself rebelled against them, and broke against their bows,—and that consequently these were slower than any of the others. All of them, however, were vessels of the first class; and he gave the details of their construction,—for which we have not space. All of them were examples of the value of the form, and the principles which the British Association had advocated and introduced at a very early period in its history.

Mr. J. Taylor stated that as Treasurer of the Association, he could bear witness to the value of the efforts of the Association in this direction; and he felt bound in justice to state, that the credit Mr. Russell

had given to the Association, was chiefly due to himself, as the individual who, with the late Sir J. Robinson, had conducted the investigations on this subject.

Mr. J. Price rose to say that he agreed with Mr. Russell in all that he had adduced. There was, however, one mode of steam navigation —one mode of propulsion to which he had not alluded, he meant the mode of propulsion by the screw propeller. He would, therefore, mention that they had built a little vessel, called the Neath Abbey, which plied from Neath to Bristol, a distance of upwards of sixty miles, and which had only two 12-inch cylinders, in fact a mere toy—of course using high steam. Now, she could walk round the Beresford, which had two 40 horse power engines:—the working her upon the high pressure steam principle necessarily increased the speed of the piston. With these engines they had stepped out of the old track. They had not adopted the American plan of a high pressure engine, and puffing off the steam, but of a high pressure engine without puffing off the steam, and without using a jet of cold water. He confessed that, when this plan was proposed by his younger coadjutors, he, as one of the old-fashioned, hesitated,—but at length he consented. The Neath Abbey had a screw propeller with three blades, which were immersed under the water—her propeller being about 3½ feet in diameter. The vessel is built in the best form, allowing sufficient breadth for her engines. The two 12-inch cylinders are placed diagonally, and slung up by wrought iron beams, and they lay hold of one crank pin, like the hands of two men working at a grindstone; and thus they conducted their engines almost in a snuff-box. They then employed their boiler in the manner described by Mr. Russell. Then they came to the condensation of the steam, which they did not allow to go puffing off, but let it pass back into the boiler, condensed and in a distilled state,—which accounted for their never having any mud or dirt in their boilers. Ibid.

AMERICAN PATENTS.

List of American Patents which issued in the month of August, 1847, *with Exemplifications, by* Charles M. Keller, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Hydraulic Engines;* James McLaughlin, Philadelphia, Pennsylvania, August 7.

The patentee says,—"My improvement consists in securing to the bottom of the valve a cross-head, having an anti-friction wheel or pulley on each extremity, which run on the under side of the bottom plate of the cylinder, for the purpose of counteracting the upward pressure of the water from the column, against the lower surface of the valve, and holding said valve firmly on its seat during the operation of the engine."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the movable cross head, anti-friction wheels, and bolt, with the valve, traversing with said valve, and holding it firmly in its seat during the operation of the engine, in the manner and for the purpose described."

---

2. For an *Improvement in Horse Powers;* David Anthony, Sharon, Schoharie county, New York, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner in which I have arranged and combined the interior segment with the driving wheel and traveling pinions, the latter moving round the former, while they turn upon their own axes, and give motion to the wheels which drive the pinion upon the sleeve."

---

3. For an *Improvement in Piano Forte Actions;* Timothy Gilbert, Boston, Massachusetts, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the spring with the lever and hammer, in such manner as to nearly or entirely remove the weight of them, or either of them, from the key lever, or top of the jack thereof, whereby I am enabled to operate or depress the front end of the key lever, with scarcely any counteracting force, other than what may be sufficient to dampen the string, and, by so doing, make the action both very light to the touch, and powerful in execution.

"I also claim the combination of the lever, with the back catch and key lever, as set forth, for the purpose of enabling the key lever and jack, to be readily removed, independently of the rest of the action. I also claim the combination or arrangement of the spring with the lever, damper lever, and key lever, by which the spring is made to answer the double purpose of causing the return of the key lever and damper, after each blow on the string."

---

4. For an *Improvement in Machinery for Twisting Withes;* Jonathan Smith, Frankfort, Waldo county, Maine, August 7.

Claim.—"What I claim as my invention, is the rotating pincer, or twisting shaft, or mandrill, (having pincers, jaws, or other appliances, for holding one end of the pole to be converted into a withe,) in combination with the rotating windlass barrel, for winding up the pole, or straining its fibres in such a manner as to secure the twist put in by the shaft; the whole being constructed and made to operate together, substantially in manner, and for the purpose of making withes, as above specified."

---

5. For an *Improvement in the Plough;* George Page, City of Washington, D. C., August 7.

The patentee says,—"The nature of my improvement consists in supplying a revolving concave disk, in place of the ordinary mould-

board, for turning the furrow, and adapting the other parts of the plough thereto."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a concave circular revolving mould-board for a plough, constructed substantially in the manner and for the purpose set forth. I also claim the outer brace and scraper, in combination with the above, for the purposes set forth; and, lastly, I claim the employment of the friction rollers, in combination with the revolving mould-board, substantially as above specified, for adjusting the heel of the mould-board, out or in, to regulate the furrow."

---

6. For an *Improvement in Propellers for Vessels;* Horace Everett, Windsor, Windsor county, Vermont, August 7.

The patentee says,—"The nature of my invention consists in providing for the more certain and accurate opening of the paddles, on the forward motion of the wheel; and in securing an efficient action of the paddles on the backward motion of the wheel; and, also, thereby rendering the wheel capable of being used as a vertical wheel; and, as such, of being placed within the body of the vessel; and, when so placed, of being raised, together with the cams, when sails only are used; and of having the paddles protected by side keels; and of being propelled by a crank at each end of the shaft, placed at right angles to each other; and of being more readily repaired at sea."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the outer cam, whereby the perfect opening of the paddles is secured, on the forward motion of the wheel, leaving the paddles free to commence closing on the backward motion of the wheel; and the combination of the modified inner cam, with the roller, whereby a chock between that cam and the paddle rollers, (on the backward motion of the wheel,) is prevented."

---

7. For an *Improvement in Cheese Presses;* Chester Stone, Rootstown, Portage county, Ohio, August 7.

The patentee says,—"The nature of my invention consists in connecting together, by means of a single rod, two frames that constitute the levers, the outer ends of which rest and run on the floor; the rod which unites these two frames being made to pass through the ends that work the platen or follower, and the frame of the bed being notched to rest on two rods, one attached to each frame, and at equal distances from the rod that connects the two frames, so that the two rods that support the frame of the bed shall constitute the fulcra of the levers."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is connecting the two lever frames and the platen or follower together, by a central rod, midway between the points of support of the lever frames, when this is combined with the supporting of the bed of the press, on the two fulcrum rods, attached to the lever frames on each side of the central rod, or connexion of the two lever frames and platen, substantially as described; whereby the levers of

the press answer the purpose of legs or supports for the whole press; and by which, also, the whole weight of the frame, and all other parts of the press, act on the lever purchase to give the required purchase."

---

8. For an *Improvement in Whiffletrees;* John McLaughlin, Gettysburg, Adams county, Pennsylvania, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the lever with the spring bolt, for attaching the traces to the singletree, and detaching them therefrom, substantially in the manner and for the purpose set forth."

---

9. For an *Improvement in Threshing Machines;* David Anthony, Sharon, Schoharie county, New York, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of constructing the beaters upon the main cylinder, and the combination of the latter with the bed cylinders, provided with disks, as described—the whole being constructed and operating substantially as herein set forth."

---

10. For an *Improvement in Wool Burring Machines;* William Cundell, Paterson, Passaic county, New Jersey, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, making the spaces or slots between the teeth of equal width from the point to the bottom of the teeth, when this is applied to teeth the peripheries of which are concentric; so that when the rings of the teeth are all put together, the outer portion of the space shall be of the same width as the space within, and the surface of each tooth, from point to back, shall be a segment of a cylinder and concentric, substantially as described. And, finally, I claim making shears or guards, for clearing off the impurities, of sheet metal, bent in semi-cylindrical form, and connected together by the edges, and with the included cylinder, by the convex surface, substantially as described."

---

11. For an *Improvement in Water Wheels;* Horace Parsons, Houston, Adams county, Illinois, August 7.

The patentee says,—"The nature of my invention consists in making the buckets of the wheel, which extend from the hub to the closed rim, in lines tangential to a circle of less diameter than the hub, and for about one half their depth, parallel, or nearly so, with the axis of the wheel, and the other half extending therefrom, at an obtuse angle, when this is combined with a small shute, for discharging and keeping the water on to several of the buckets at the same time, to act by the percussion and pressure due to the head—the tangential direction of the buckets directing the bulk of the water towards the rim of the wheel, and with a plate on the discharging face of the wheel, which is provided with only one aperture below the axis of the wheel, to

prevent the escape of the water from the buckets, before it shall have exerted its full force on the wheel, and then to exert a force on the oblique position of the buckets, as the pressure in the shute forces the water out of the buckets through this aperture."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the making the wheel with buckets formed with about one-half their depth parallel with the axis of the wheel, and tangential to a circle smaller than the hub, or thereabouts, and the other half an angle therewith, when this is combined with a scroll shute on one face, for the admission of the water, and a retaining plate on the other, provided with a hole for the discharge of the water, opposite the end of the scroll, substantially as described."

---

12. For an *Improvement in Screw Propellers;* James Montgomery, Memphis, Shelby county, Tennessee, August 7.

The patentee says,—"The nature of my invention consists in constructing a cylinder in the dead wood or other part of the vessel, and in placing within the cylinder so constructed, a second cylinder, containing a screw, the edges of which are firmly secured to this second cylinder, which is thereby made to revolve with the screw. Also in the manner of admitting the water to the screw or propeller, by an opening in the front or outer cylinder."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the propeller in the manner described, namely, an Archimedian screw, or a screw to which an outer rim is attached, to strengthen it, the whole being surrounded by an additional casing, which outer case effectually protects the propeller from injury, and by which a more perfect action is insured."

---

13. For an *Improvement in Mortise Latches;* Rhodolphus Kinsley, Springfield, Hampden county, Massachusetts, August 7.

The patentee says,—"The method of making the cases of mortise latches, &c., for which I now claim letters patent, is an improvement on the mode secured to me by letters patent, bearing date the seventh day of March, in the year 1846, and consists in making it in the form of two parallel cylinders, united together by a plane which takes from each cylinder about one-eighth of its circumference, instead of forming it, as under my former patent, by the union of three cylinders, so that a case of about one inch in width can be inserted without mortising, by simply boring two holes, parallel, that run into each other—thus making a latch with a tumbler lever of nearly an inch in length, with a case of only half an inch in the thickness, that can be let into a door, by simply boring instead of mortising, as was the practice prior to the date of my before-recited patent; the bar of the bolt working mainly in one of the cylinders, and the helical spring, which projects the bolt in other cylinders, and the bridle or stirrup of the bolt, on which the lever or tumbler of the spindle works, and which requires considerable thicknesses of metal, also working in the two hollow cylinders, while

the other parts of the bar of the bolt are made thinner, to work in between the two plates, where the two cylinders run into each other."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is making the case of mortise latches or locks in the form of two cylinders, united and running into each other, the chord where the two cylindrical forms are united being less than their diameter, substantially as described; when this is combined with the bolt, arranged with its greatest width in a plane passing through, or parallel with, the axis of the two cylinders composing the form of the case, in the manner and for the purpose described."

---

14. For an *Improvement in Machinery for Making Sheet Lead;* John Robertson, Brooklyn, Kings county, New York, August 7.

The patentee says,—"The nature of my invention consists in forming lead, (or other metal, or compounds of metals having like qualities,) into sheets, by making pressure on a portion of the surface of a mass of metal, in a chamber of the length of the intended width of the sheet or sheets, and thus causing the metal to rise in a thin sheet or sheets, between the surfaces of the chamber containing it, and the die on the face of the ram, by which pressure is made. The ends of the ram or die, thus acting on the surface of the metal to be formed into sheets, being guided at each end in such a manner as to insure parallelism of action, relatively to the face or faces of the chamber containing the lead, or other metal, or compounds thereof."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of making sheets of lead, or other soft metal, or compounds thereof having like or similar qualities, by making pressure on a portion of the surface, and causing it to rise in the form of a sheet or sheets, in a space or spaces, left between a long chamber containing the metal and the die, or through a space in the die, the said die being equal in length to the width of the intended sheet or sheets, and having its ends guided by, and working in, a corresponding chamber, containing the metal to be formed into sheets, substantially as described. I also claim, in combination with the ram, die, and chamber, the end guides, that guide the ram in its movements, and separate the lead from the ends of the chamber, and prevent it from being forced in between the ram and the chamber to choke the machine, substantially as described."

---

15. For an *Improvement in Reaping Machines;* Obed Hussey, Baltimore, Maryland, August 7.

The patentee says,—"The improvement for which a patent is now asked, is fastening the upper piece of the guard to the lower piece only at the point, leaving the back end unconnected; consequently the space between the lower and upper pieces of the guard, through which the blades vibrate, is open behind, so that the grass, &c., which is forced in, by the action of the blades, now passes freely out through the opening; which opening, when used in combination with vibrating blades,

constitutes a claim in this improvement. My improvement extends also to the prevention of the accumulation of grass, &c., under the blades."

Claim.—"I claim the opening above the blades, in combination with vibrating blades. I also claim the particular application of the flush edge at the fork of the blades, for the purpose described."

---

16. For an *Improvement in Harvesting Machines;* Martin Butts and Laurett Church, (administrators of the estate of Damon A. Church and others,) Friendship, Allegheny county, New York, August 7.

The patentees say,—"It has been found that the knives, although made and joined together with the utmost care, eventually become open in the joint, lose their interior cutting angle, and admit the fibres of vegetable matter between them. This difficulty is obviated by constructing the knives so as to be solid in that part."

Claim.—"What we claim as new, and desire to secure by letters patent, is the forming such knives solid at their inner angles as described."

---

17. For an *Improvement in Water Wheels;* William Lamb, Rome, Oneida county, New York, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the above described horizontal water wheel, in combination with the method of introducing water thereto, viz: by a curb connected with, and forming part of a wheel, to save and give direction to the water, and the form and position of trunk noses, as herein described."

---

18. For an *Improvement in Combining a Rocking Chair and Fan;* Charles Horst, of New Orleans, Louisiana, August 7.

Claim.—"What I claim as new, and desire to secure by letters patent, is the placing the fan in a frame secured to the back of the chair, and projecting over the seat of the same, combined with the cords and base pieces, (or a platform,) to which the rockers are connected, in such a manner that the vibration of the chair on its rockers, will impart motion to the fan, substantially as set forth."

---

19. For an *Improvement in Fire Grates;* William H. Pulver, Troy, Rensselaer county, New York, August 7.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the manner of dividing the grate into compartments, by means of serrated or interlacing bars or teeth, having an oscillatory or semi-revolving motion with the transverse bars, of which they form a part, or to which they are united; and this in combination with the rock shaft, through which the said motion is propagated from the lever."

20. For an *Improvement in India Rubber Shoes;* Robert Story and Thomas Hopper, New Brunswick, Somerset county, New Jersey, August 7.

The patentees say,—"The nature of our invention consists in preparing the shoes. Metallic rubber gum is manufactured from a compound of India rubber, sulphur, litharge, and camphene. The metallic gum for the manufacture of shoes, is cut and fitted on lasts of various sizes; the bottoms receive a sole and heel of cloth, prepared with the metallic gum on the inside, for the purpose of adhering to the shoe, in the process of curing in the heated chamber. And when the shoe is cured, the fitted parts become perfect, and form a shoe ready for the adaptation of the leather sole."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the attaching leather soles to metallic rubber shoes, by means of a sole and heel of cloth, prepared with metallic gum on the inside, for the purpose of adhering to the shoe, in the process of curing in the heated chamber, and when cured, they are ready for attaching the leather sole and heel as named."

---

21. For an *Improvement in Lighters for Vessels;* Henry Stanton, City of Washington, D. C., August 14.

The patentee says,—"The nature of my invention consists in constructing the sides of the boat straight from bow to stern, for the purpose of giving the required strength, when this is combined with projections on each side, towards the bow and stern, for the purpose of making recesses at each side, to receive air-tight bags called "safety spars," made of India rubber cloth or other appropriate substance, the bags being protected from the injurious effects of snags, floating wood, &c., by these projections; and also in making the boat with beams passing entirely through the boat, and projecting sufficiently beyond each side, to receive and guard the safety spars which are attached to them, so that the whole strain in lighting or floating a steamboat or other vessel, shall be mainly borne by these beams instead of the body of the boat."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the boat with the sides of straight truss frames, connected with the bottom by means of the knee timbers, that lap on to each other in the middle of the boat, and secured to the keelsons and bottom by the interposition of cross timbers, substantially as described, (whereby great strength and stiffness is given to that part of the boat which has to sustain the strain as described,) when this is combined with the safety spars or floats, for giving additional buoyancy, as described.

"Secondly, I claim constructing the boat so as to be more buoyant towards the bow and stern than along the middle sections, by carrying out the sides, towards the bow and stern, beyond the truss frames that constitute the sides of the narrow part, in combination with the mode of constructing the frame of the boat, and with the auxiliary floats or

safety spars, which give the required buoyancy to the narrow part, substantially as described, the projections towards the bow and stern answering the double purpose of giving the required buoyancy at the ends, and protecting the auxiliary floats or safety spars, as described.

"And finally, I claim, in combination with the safety spars, making the guards to which the safety spars are to be secured, by passing the beams through the side frames, and below their upper edge, in combination with the mode of giving the required strength to the connexion of these with the boat, by bolting the beams to the top of the outside knees, and to the sides of the inside knees, the inside and outside knees being connected together substantially as described; whereby the required strength is given to the guards to resist the upward force of the safety spars."

---

22. For an *Improvement in Packing and Pressing Cotton;* Mary Ann Mead, administratrix of James Mead, Aurora, Dearborn county, Indiana, August 14.

The patentee says,—"The main feature of my invention consists in an arrangement for pressing cotton into a uniformly dense mass, as it is gathered, by small increments round a spindle, more effectually, and with much less expenditure of power than is commonly employed to press the whole bale at once."

Claim.—"What I claim as new, and desire to secure by letters patent, is the apparatus for forming a bale of cotton, under pressure, on a spindle or revolving rod; but I do not intend, by this specification, to limit myself to the precise arrangement herein described, so long as I attain the same end by equivalent means."

---

23. For an *Improvement in Casting Ordnance, &c.;* Thomas J. Rodman, Fittsburg, Allegheny county, Pennsylvania, August 14.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the cooling from the interior of the guns, or other heavy hollow castings intended to resist a central force, by circulating within the core a cooling fluid or gas, in combination with the application of artificial heat at the exterior of the flask, to prevent cooling from without."

---

24. For an *Improvement in Planting Machines;* Richard Craggs and Oliver Reynolds, Webster, Monroe county, New York, August 14.

The patentees say,—"Our essential improvements are three in number, and are deemed indispensable to the proper action of the machine, namely:—1st, The addition of the revolving breaker, for breaking the manure in the manure box. 2d, In making the drills with round points, for going over stones, stumps, and other obstructions, with facility. 3d, In a new mode of arranging the cultivators on separate beams, between the drills, so that they shall move independently of each other."

Claim.—"What we claim as our invention, and desire to secure by

letters patent, is, 1st, The revolving manure breaker and pulverizer, when placed in the front part of the hopper, and in front of the revolving conveyor, in combination with the manure box or hopper, substantially as herein described, whereby the manure is broken, pulverized, and worked to a suitable degree of fineness for being conveyed into the jointed conducting tube, along with the seed to be planted; thus dispensing with the services of the attendant, whose duty has heretofore been to agitate and break up the manure in the hopper with a fork, or other implement, and discharge the same into the concave of the revolving conveyor, during the progress of the machine. 2d, We also claim the particular form of the front or cutting part of the drill, as combined with a separate adjustable jointed beam and conducting tube, passing through the same."

---

25. For an *Improvement in Drying Grain, Flour, &c.;* James R. Stafford, Cleveland, Ohio, August 14.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of drying or cooling grain, flour, meal, or other substances on the external surface of a hollow cylinder, armed with flanches, or other devices, arranged and operating substantially as described, and combined with a trough—the cylinder to be filled with hot air when used for drying, and with cold air when used for cooling purposes as set forth.

---

26. For an *Improvement in Cooking Apparatus;* B. Antognini, New Orleans, Louisiana, August 14.

Claim.—"What I claim as my invention, and desire to secure by letters patent, are the following parts: 1st, The division of the cover, or upper surface of my furnace, into several parts, each of those parts bearing one furnace. 2d, The use of partitions which isolate each furnace, and, in combination therewith, the use of the little door of each furnace, which partitions and doors govern the fire as required; thereby presenting all the advantages of the chimney, or of the smoke apparatus, without their nuisance, owing to the use of charcoal."

---

27. For an *Improvement in Wool Burring Machines;* Francis A. Calvert, Lowell, Middlesex county, Massachusetts, August 14.

The patentee says,—"By my improvement the saw guard cylinder is made entirely solid, or in one piece, and the teeth are shaped or cut on the same, so as to operate more effectually in cleaning out the burs, and less injurious on the staple of wool or other fibrous material."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is a saw guard cylinder, made in one solid piece, with the teeth and grooves shaped and set spirally, substantially as herein set forth."

28. For an *Improvement in Coupling Line Shafts;* E. M. Rice, Worcester, Worcester county, Massachusetts, August 14.

The patentee says,—"The nature of my invention consists in coupling shafts by means of a ring that fits over the periphery of the two flanches, disks, or plates, on the end of the two shafts, the ring being provided with longitudinal feathers, to fit corresponding grooves in the periphery of the two flanches, disks, or plates; so that, by simply sliding off the ring, the two are disconnected, and in this way any section of a shaft can be taken out without the necessity of moving the remaining portions of the shafting, as the projection of the one into the other is entirely avoided, when this is combined with the mode of clamping together the two disks, by means of screws that pass from a flanch of the ring that rests against one of the disks, and tapped into the other disk, one of the disks being thus clamped between the flanch of the embracing ring and the other disk, the screws passing through the parts, and being tapped into the other, or screw bolts passing through the three, with nuts outside."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of coupling shafts by means of the circular flanches, disks, or plates, on the ends thereof, and grooved or feathered on their periphery, on lines parallel with a ring which fits on the periphery of the flanches, disks, or plates, substantially as described, in combination with the mode of clamping the two disks by screws passing through the two disks, and the flanch of the embracing ring, whereby the projection of one shaft into the other, as a means of pressing them in the same central line, is obviated, as described, and, at the same time, the two shafts are clamped together endwise, to prevent sagging and wabbling, as described."

---

29. For an *Improvement in the Steering Apparatus;* Jesse Reed, Marshfield, Plymouth county, Massachusetts, August 14.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of an endless screw and its nut, arranged as described, so as to move longitudinally forward and back, with the button connected to the rudder head, or a cap on the same, and the curved arm connected to said head or cap, and to the nut, all as above set forth, and the arrangement of said parts as above described, so as to have but one bearing extraneous to the rudder post, and thereby permit said post to rise without breaking or deranging the apparatus, and also any mechanical devices substantially the same, and combined substantially in the same manner, for forming a steering apparatus."

---

30. For an *Improvement in Casting Door Plates;* J. A. Pease, Philadelphia, Pennsylvania, August 14.

The patentee says,—"The nature of my invention consists in the combination and arrangement of a mould, and a movable set of letters of the alphabet, or types, cut with a bevel on each side, in order to

keep them from slipping out of their places, and for the purpose of casting door plates, &c., in one solid piece, with the name sunken into the face of the plate, said letters or types serving as a matrix, and are raised, for said purpose, above the surface of the groove at a suitable height."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination and arrangement of a mould and the letters of the alphabet, as described, for the purpose of casting door and other plates, with the letters or name sunken in the face of said plate, and said plate, when cast, together with said letters, to be cast in one solid piece, and in one operation."

---

31. For an *Improvement in Boot Patterns;* Simon C. Shive, Bloom township, Columbia county, Pennsylvania, August 14.

The patentee says,—"The nature of my invention consists in combining several plates of metal, or other material, one with another, in such a manner, so that when thus combined, they will form a boot pattern which can be adjusted, at one operation, to any required size, by means of the simultaneous and proportional extension of the several parts."

Claim.—"What I claim as new, and desire to secure by letters patent, is the adjustable character of the patterns at one operation, or, in other words, the simultaneous and proportional extension of the several parts composing them, arranged in the manner, and for the purpose herein set forth."

---

32. For an *Improvement in Rivets for Leather Bands;* F. W. Wood, City of New York, August 14.

Claim.—"I claim as my invention the application of rivets, so formed in the head, conjointly with a feather-edged burr, having a concave or dished face, with a conical hole, to receive the clench, and finish the rivet flush with the faces on both sides of the band, substantially in the manner set forth."

---

33. For an *Improvement in Riveting Leather Bands;* Wm. H. Jenison, assignor to Wm. Kumbell, City of New York, August 14.

The patentee says,—"The nature of my invention consists in making the head of the rivet concave, and the shank oval."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the above described form of rivet, in combination with, and for the purpose of, uniting leather belts, substantially as described, which I call the concave head and oval shank rivet."

---

34. For an *Improvement in Baskets;* Abraham Van Riper, Washington, Bergen county, New Jersey, August 21.

The patentee says,—"The object of my improvement is to prevent the bottoms of fruit baskets from sinking or falling down. This I effect by introducing two hoops, of about ¼ of an inch thickness—the

one on the bottom of the inside of the basket, and the other on the bottom of the outside of it. These hoops are connected by rivets or nails, and thereby securing between them the standards of the basket."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of two hoops, fastened together by nails or rivets, so as to enclose the standards which form the arched bottom of the basket, and prevent them from yielding or falling down, by the pressure of fruit, &c., which the basket may contain."

---

35. For an *Improvement in Cooking Ranges;* Samuel Pierce, Troy, Rensselaer county, New York, August 21.

The patentee says,—"The nature of my invention consists in heating the oven or ovens, by means of currents of air, which are heated in passing through chambers surrounding the fire place, and which, after passing through the oven or ovens, are discharged into the closed ash pan, to supply the combustion in the fire chamber."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is heating the oven or ovens, by the passage through it or them, of a current or currents of air, heated on its or their way to the oven or ovens, by passing through chambers surrounding the fire chamber, substantially as described; when this is combined with the discharge of the current or currents, from the oven or ovens, into a closed ash pit, to supply the combustion in the fire chamber as described; whereby the combustion insures the passage of the current or currents, through the oven or ovens, substantially as described."

---

36. For an *Improvement in Setting and Filing Saws;* Charles Lafferty, York Springs, Adams county, Pennsylvania, August 21.

The patentee says,—"The nature of my invention consists in the construction and arrangement of the clamp for holding the saw for setting and filing, and in combining therewith, a guide for the file, and a gauge and tool for setting the teeth."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing a saw set in the manner described, by having one jaw raised above the other, and beveled on the face, with a rib behind, as described, by which the teeth are set by a toothed lever, that hooks over said rib, and brings the tooth against the teeth of the saw as specified—the width of the set of the teeth being determined by the gauge, substantially in the manner and for the purpose set forth. I also claim the filing apparatus, constructed substantially as herein made known, consisting of a file holder, consisting of a standard that slides parallel in front of the jaws of the clamp, to which the file is so attached as to have a free motion, horizontally, in any direction to which it is set, and so regulated as to file to any given depth the holder is set for, so that it will direct the file to the proper angle and depth on the saw, in the manner and for the purpose above specified."

37. For an *Improvement in Winnowing Machines;* Jacob Behel, Mifflintown, Juniata county, Pennsylvania, August 21.

Claim.—"What I claim as new, and desire to secure by letters patent, is the forming a series of shoulders, one above another, on the inclined board forming the bottom of the hopper, in combination with the reciprocating longitudinal movement of the same, for the purpose of regulating the feed from the hopper, substantially as herein set forth. I also claim the combination of the separator shaft with the shoe, and with the pitman, by means of the crank and vertical pitman, for the purpose of imparting to it a reciprocating horizontal movement, and a vibratory movement on its axis at the same time, substantially in the manner, and for the purpose herein set forth. I also claim the combination of the screen and the slats with the apron, substantially in the manner and for the purpose herein set forth."

---

38. For an *Improvement in Machinery for Rasping Dyewoods;* C. W. Roberts and John Hambly, Philadelphia, Pennsylvania, August 21.

The patentees say,—"The rasping wheel in our machine is composed of a series of circular saws, secured to a shaft in such a manner as to give them an oblique inclination to the same, so that, as they are revolved, the rasping action of the saws will operate on the wood, to the right during one half of the revolution of the saws, and to the left during the other half. By means of this arrangement of the saws, they can be placed at a very considerable distance from each other, and yet their teeth will operate upon the entire surface of the substance placed in contact therewith."

Claim.—"What we claim as new, and desire to secure by letters patent, is the constructing the rasping wheel of a series of parallel circular saws, secured to the shaft in an oblique position thereto, so that their rasping action will operate on the wood, to the right during one half their revolution, and to the left during the other half, substantially in the manner and for the purpose set forth."

---

39. For an *Improvement in Window Blind Fasteners;* James M. Evarts, New Haven, Connecticut, August 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of attaching the spiral spring to the catch by a pin or bolt, extending through the whole length of the spiral spring, from the projection to the hole, and thus securing the spiral spring in its proper position, so that it may work freely, be secured from liability to get cramped, and prevent it from being thrown out of its place by any accident; the whole being constructed and operating as set forth."

---

40. For an *Improvement in Manufacturing Lead Pipe;* Samuel G. Cornell, Greenwich, Fairfield county, Connecticut, August 21.

The patentee says,—"My invention consists of certain improve-

ments in the arrangement and combination of the machinery or apparatus heretofore used for similar purposes, and in the construction and application of certain additional machinery or apparatus, and the combination thereof with the other apparatus as described."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is placing the die for forming the interior surface of the pipe, in the piston or hollow mandrel, as the case may be, substantially as described, instead of placing it in the head of the lead cylinder, as has been heretofore done; so that as the piston is forced into the cylinder, or the cylinder forced over the piston, the pipe will be formed at the point of pressure, without moving the mass of lead relatively to the cylinder; and, in combination therewith, I claim the cores for forming the interior surface of the pipe, the die and core being adjusted and held in their proper relative positions by any of the known methods."

---

41. For an *Improvement in Safety Apparatus for Steam Boilers;* Timothy Clark, New Haven, Connecticut, August 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the application of an elastic vessel as described, instead of the piston, whereby the friction of the piston is avoided, and the operation on the damper rendered much more uniform; the whole constructed and operating substantially as herein described."

---

42. For an *Improvement in Fishing Hooks;* Stanton Pendleton, New Haven, Connecticut, August 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the attaching of the common fish hook to the 'spring fish hook,' (claimed to have been invented by Griswold, as the 'sock-dologer hook,') patented by Englebrecht & Skiff, by means of a screw spring and catch, or any other convenient method, so as to be readily attached, detached, or changed at pleasure, in manner and form substantially as described."

---

43. For an *Improvement in Fishing Hooks;* Job Johnson, Brooklyn, Kings county, New York, August 21.

Claim.—"What I claim as new, and desire to secure by letters patent, is the original application of the stock or frame piece, the original application of the helical contractile spring, together with the original constructive arrangement of the parts, for these purposes, conjointly with a crooked and barbed dart, acting through the cock pin, trigger lever, and contractile helical spring, to strike the fish or animal, by disengaging the dart from the trigger, through the combined action of the changeable hook with and upon the foregoing parts; the whole constructively arranged and combined to strike the fish or animal, biting at or touching the bait on the hook, the whole effected without any action of the line, or of the person holding the line, substantially as described.

"I also claim the application of the guard ring, to protect the user from injury, by the dart accidentally disengaging while setting the bait for use."

---

44. For an *Improvement in Thinning Cotton;* Elijah M. Morris and James Cleghorn, Cartersville, Cass county, Georgia, August 21.

The patentees say,—"The nature of our invention consists in the application of the axletree and wheels to the thinning of cotton."

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combination of the handles with the axle and hoe frame, as described; the handle and hoe frame being independently attached to the axle which forms the fulcrum, and the relative position of the handles and hoe frame being adjustable, the handles are converted into adjustable levers for elevating and depressing the hoes."

---

45. For an *Improvement in Cooking Stoves;* P. Whiteside, Weedsport, Cayuga county, New York, August 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, first, the diving flues at the back, in combination with the horizontal flues between the top and bottom ovens, and the two dampers in the diving flues, substantially as described, whereby the draught can be carried under the top oven, independently of heating the lower oven, when it is desired to use the top oven alone, as described. Second, the placing a partition in the main return flue, to turn the draught from the two side flues, and prevent them from acting against each other, or uniting to impede the draught until after they have been thrown in the direction of the main return flue, substantially as described."

---

46. For an *Improvement in the Mode of Heating Wheel Tires;* Alva Gregory, Pike, Wyoming county, New York, August 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the invention of a circular furnace for heating carriage tires, by confining the heat as described; and in carrying out that principle, I do not intend to limit myself to any particular materials or dimensions in constructing the furnace, whilst I attain the same end by substantially the same means."

---

47. For an *Improvement in Cooking Stoves;* Nathaniel Bosworth, Jr., Troy, Rensselaer county, New York, August 28.

Claim.—"What I claim, and desire to secure by letters patent, is dividing the space between the front of the fire box and the front of the stove, vertically into three portions, the two outer communicating at the bottom with the flue beneath the oven, and connected at the top by a horizontal cross flue; while the middle portion or space between these latter, constitutes a flue for the furnace in the sunk hearth, communicating by a damper with the cross flue before mentioned,

and through this latter with the smoke pipe, and serving, likewise, to receive and heat the current of external air before it passes beneath the grate of the fire chamber. And in combination with the foregoing, I also claim the manner in which (by the arrangement of the register in front of the hearth plate, and the interior plate forming the passage) I introduce the draught of external air, both to the hearth furnace and principal fire chamber."

---

48 For an *Improvement in Mills for Grinding Mustard, &c.;* Chas. Walker, Brooklyn, New York, August 28.

The patentee says,—"The nature of my invention consists in the construction of a machine or mill for pulverizing mustard seeds, grain, drugs, and other like things, especially gummy or oleaginous substances; the peculiar properties of said machine or mill being rapidity of action, without becoming clogged with the matters it pulverizes, no matter how sticky their nature."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar combination of the segments with one another, to form a ring of wood, so that the ends of their fibres shall make the wearing surface for the purpose herein described. Also the combination of the movable partition and block with the balls and the ring, in manner and for the purpose set forth."

---

49. For an *Improvement in Curry Combs;* John Jones, Bristol, Hartford county, Connecticut, August 28.

The patentee says,—"The nature of my invention consists in making a piece of sheet metal of either brass or iron, the width of said sheet is the width of the curry comb, said sheet is slitted or slotted out, to admit of the rows of teeth in the comb to pass through the sheet metal between the slots being left and occupying the space between the rows of teeth, one end of said sheet is jointed or hinged to the comb, on the other end is a spring for fastening it to the back of the comb when used. It must be evident to all, that as the teeth pass through the narrow slots, if they become filled up, while the cleaner is below their points, they will be entirely freed from dirt when the cleaner is raised up; this being done, the cleaner is replaced again and ready for use."

Claim.—"What I claim and desire to secure by letters patent, is the combination of the cleaner as herein described, or any other substantially the same, with the curry comb, substantially in the manner and for the purpose set forth."

---

50. For an *Improvement in Apparatus for Retarding the Motion of Wheel Carriages, called the "Self-Acting Brake;"* Christian Stoner, Gettysburg, Adams county, Pennsylvania, August 28.

The patentee says,—"The nature of my invention consists in so modifying and applying E. Slifer's apparatus for the above named purpose, patented in 1826, as to render it practicable and useful for the purpose intended, and imparting to the apparatus, by a peculiar

mode of combining and arranging the several parts, a quality not heretofore possessed by it, or any other apparatus for retarding the motion of wheeled carriages, namely, that of causing the levers and spring to act simultaneously in drawing the rubbers against the peripheries of the wheels, whilst the carriage is moving forward, by its momentum and gravity, at a greater speed than that of the horses, and to throw the rubbers from the wheels when the motion of the carriage has become reduced; also, in keeping the central connecting rod extending from the lever at the end of the pole to the branches that connect with the L shaped levers, parallel with the centre of the pole and perch, during the operation of turning the carriage."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The manner of retarding carriages in descending hills, by the combination of the crossed levers, cranks, parallel connecting rods, and springs, arranged and operated in the manner set forth. 2d. I likewise claim making the rod to retain its central position beneath the pole or perch and tongue, whilst turning the carriage in the manner described, by having an oblong link formed in it at the coupling bolt, in the manner above set forth, by the combination of the triangular plates and short rods."

---

51. For an *Improvement in Tanning Hides or Skins;* Alexander Turnbull, Surrey county, Kingdom of Great Britain, August 28.

The patentee says,—"The nature of my invention consists in the adaptation of a newly discovered law, called Endosmosis and Exosmosis, to the tanning of hides and skins, and also in the use of sugar, or saccharine matter of any description, for the purpose of extracting the lime from hides and skins before being tanned."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, First, The discovery of the means of extracting the lime with which the hides and skins are impregnated, in removing the hair by the use of sugar or any other saccharine matter, whether obtained from the sugar cane, honey, beet root, turnips, potatoes, the maple tree, or any other vegetable substances.

"Second, I claim the discovery of the application of the law of Endosmosis and Exosmosis to the purposes of tanning, with the materials and in the manner before described, or in any way wherein the hide or skin can be placed between the fluids containing tannin or tannic acid of different specific gravities."

---

52. For an *Improvement in Cooking Stoves;* Samuel Shreve, Burlington, New Jersey, August 28.

The patentee says,—"The invention and improvement I have made consists in a new arrangement of some of the flues and dampers, with others of the ordinary arrangement, for the purpose of applying the heat to the ovens in a more advantageous manner, to produce a more regular heat in the same, by a reduced consumption of fuel, and in having a more complete command over the dampers in changing the

direction of the heat, so as to apply it to any particular part of the stove that may require to be heated; and also for shutting off the draught through the same, and confining the heated gases therein, for the purpose of keeping the ovens at a proper degree of heat when not required to bake quickly."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is, 1st, The arrangement of the dampers, in combination with the flues for converting these flues and other flues into hot air chambers, in the manner and for the purpose set forth.

"2d. I claim arranging the smoke pipe near the bottom of the stove, in combination with the additional flue, arranged between the flue and the ovens as described.

"3d. I claim the manner of combining the two front corner flues with the broad transverse flue beneath the hearth plate as described."

---

53. For an *Improvement in Mills for Grinding Corn in the Cob;* Amory Fisher, Tuscaloosa, Alabama, August 28.

Claim.—"What I claim as new, and as an improvement on that patented by James Miller, is the combining of the knives or crushers with the mill stones, in the manner set forth, the upper stone being stationary, and being provided with a feeding opening or openings, and a cutter or crusher, situated in the cavity made in said stone, to admit the revolving knives affixed in the stationary stone; these parts being combined, arranged, and operating, in the manner and for the purpose set forth. I also claim the manner of arranging the hoops in such a mill, in order to insure the ready delivery of the ground stuff. I do not claim either of the devices in my first claim individually, but I do claim them in their combination, as producing the useful results herein made known."

List of American Patents which issued in the month of November, 1842, *with Exemplifications, by* CHARLES M. KELLER, *late Chief Examiner of Patents in the U. S. Patent Office.*

1. For an *Improvement in Gas Meters;* John Hemming, North Bank, Middlesex county, England, November 4.

The patentee says,—"My improvement consists in a self-acting apparatus, for maintaining the liquid in the gas meter at a uniform altitude, in the employment of a liquid that does not freeze at the ordinary temperature of freezing water, and in protecting the metals composing the meter from voltaic or chemical action."

Claim.—"I claim the construction of the gas meter with a supply cistern attached to it, and a tube for conducting liquid from said cistern to the meter, the latter having a syphon connected with it, for the purpose described, the whole being constructed, arranged, and operating in the manner set forth."

2. For an *Improvement in Strabismus Goggles;* Andrew Lake, Flat Bush, Kings county, New York, November 4.

The patentee says,—"The nature of my invention consists in an instrument which is worn by the patient, shaped somewhat like a pair of goggles; which is so constructed that the patient turns the affected eye, when looking at objects, in a direction directly the opposite to that which it takes when in the act of squinting."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of curing strabismus or squinting, by causing the patient to see objects directly opposite to that which it takes when in the act of squinting, whether by the above described instrument or any other the same in principle."

---

3. For an *Improvement in the manner of combining an apparatus for Disengaging Horses from Carriages, and of Arresting the Motion thereof;* Jacob Harlecker, Lancaster, Lancaster county, Pennsylvania, November 4.

The patentee says,—"For the purpose of disengaging the horse or horses, in case of their running away, I so connect a strap or line with two spring bolts, by the outer end of which the traces are held, as that the driver, by drawing upon said strap or line, may retract the bolts, and liberate the horse or horses from the shafts, and may also raise and hold up the shafts, so as to prevent their falling and coming in contact with the ground. For the purpose of arresting the motion of the carriage, I place a lever along the perch of the carriage, which lever is so constructed as that its rear end shall form a forked drag, which may be brought into contact with the ground, by drawing upon the opposite end of the said strap or line, or of a separate strap or line attached thereto."

Claim.—"I claim the combining with such disengaging apparatus the lever drag and its appendages, arranged and operating substantially as herein set forth."

---

4. For an *Improvement in Boots and Shoes;* John Dick, Philadelphia, Pennsylvania, November 4.

The patentee says,—"My improvement consists in the inserting of an elastic metallic shank, made of thin sheet steel, or of a plate of other elastic metal, between the out and insole of the boot or shoe, which elastic shank is to extend from the ball of the boot or shoe to within about a fourth of an inch of the heel ran."

Claim.—"What I claim as new, and as constituting my invention, is the insertion of elastic metallic shanks, formed and applied substantially in the manner herein set forth, between the insole and outsole of boots, shoes, and pumps, of all descriptions, to which they can be applied."

5. For an *Improvement in Manufacturing Axes;* Isaac W. Turner, Baltimore, Maryland, November 4.

The patentee says,—"The principle consists in the employment of dies or swedges. The metal being prepared and placed in said dies, is subjected to a welding and condensing pressure, either by a drop, a screw, a roller, or a wedge pressure."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of forcing or hugging the pieces of dies up together horizontally on the anvil, by the levers and straps, and the fulcrums, whilst the top piece of the die, attached under the drop or pressing hammer, is forcing downwards, as before described, for the purpose of constructing axes and other tools."

---

6. For an *Improvement in the Machine and Process of Blowing or Cleaning Furs;* John W. Cochran, City of New York, November 4.

The patentee says,—"The invention or improvement claimed is, First, The obtaining on this plan a passage way or fur duct, of sufficient length to perfect the separation of the hair from the fur in one operation, and the extension of it to any required length, in an ordinary sized room, by increasing the number and length of the flues.—Second, The process of coating the flues by the use of water, as well as any adhesive substance, to catch and retain the hair as described, instead of the cloth covering now generally used for that purpose,—the value of this part of the improvement being the facility with which the coating is obtained, and the saving of time and labor. And, lastly, that, by the draught or suction caused by the blower, the fur can be drawn through the openings, (or some other convenient place,) direct from the breaker or cutting machine, into the wheel house, by means of a flue or conductor."

---

7. For an *Improvement in Lamps for Volatile Materials;* Augustus V. H. Webb, City of New York, November 4.

The patentee says,—"The nature of my invention consists in obstructing the passage of liquids, by means of an air tight stop cock, or other apparatus substantially the same, attached between the floor of the fountain or reservoir, and the burners, thereby preventing the liquid from flowing into and finding its level in the burner; the obstructing cock or apparatus being so constructed as to enable the operator to graduate the stream or quantity of liquid admitted from thence to the burner, in just such quantities as the construction or dimensions of the burner, or the nature of the liquid to be burned, may require."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the mode of regulating the flow of the oil, or other inflammable liquid, to be consumed in the lamp, in combination with the burner without a wick, as described, for producing the light; whether constructed in the manner above set forth, or in any other mode substantially the same, for affording artificial light."

8. For an *Improvement in Composition for Preserving Leather;* T. P. Merriam, New Bedford, Bristol county, New York, November 4.

The patentee says,—"Supposing the whole composition to be divided into equal parts by weight:—I take about six parts of logwood, five of oak and hemlock bark, and these I boil in a sufficient quantity of water for two or three days, so as to make a strong decoction, which I strain off. I then take two parts of Bristol lustre, or black lead, two parts of copperas, and two parts of nutgalls, and boil these together, strain the mixture, and add it to the former decoction. I next boil together about two parts of neat's-foot oil, two parts of olive oil, one part of linseed oil, and one part of beeswax, which I add to the mixture as before, together with about one part of spirits of turpentine, one part of aqua ammoniæ, and four or five parts of soap. This constitutes the whole mixture or compound."

Claim.—"What I claim, therefore, as my invention, and desire to secure by letters patent, is the preparing of a compound for the preserving and renovating of leather, which shall consist generally of the ingredients herein designated, with only such variations as will leave it as a whole, substantially the same with that herein fully made known."

---

9. For an *Improvement in Paddle Wheels or Propellers;* A. R. Chase, Cincinnati, Hamilton county, Ohio, November 9.

Claim.—"I do not claim to be the first who has applied a gearing of cog wheels and pinions, to regulate and determine the manner in which the buckets shall dip into and leave the water; but what I do claim, is the effecting of this object by the attaching of the wheel to the shaft of the paddle wheel, and the combining of the same with the regulating wheel, by means of the small wheels or pinions, and the regulating wheel being also made to drive the pinions on the shafts of the buckets, the whole apparatus being arranged and operating substantially as herein set forth."

---

10. For an *Improvement in an Apparatus to Prevent Steam Boilers from Bursting;* Thomas S. Easton, Mobile, Alabama, November 9.

The patentee says,—"The nature of my invention consists in a steam chest placed within the boiler, and on top of the flues or flue, if a flue boiler; if the boiler is without flues, the steam chest is secured to the shell of the boiler, on a stand that will lift it above the water line."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the employment of a steam chest within the boiler, provided with a pipe to carry off the steam, and a valve in its upper part, opening downwards, for the purpose and in the manner described. I also claim the feeler, in combination with a valve within the boiler, for the purpose of opening the valve from without the boiler, as described."

11. For an *Improvement in Making Cassimere Hats;* Oliver Brooks and J. A. Sloan, Philadelphia, Pennsylvania, November 9.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the method of making cassimere hats, by constructing an outside seamless cover, made of wool, or other material of which wool is a component part, to fit and be attached to a previously formed shell or body, constructed in the usual manner; the whole to be effected in the manner described, or in any other substantially the same."

---

12. For an *Improvement in Padlocks;* E. H. Roper and W. Ball, City of Washington, D. C., November 9.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the construction of our tumblers in such a form as to be on a balance on all sides of the pin, and in their having rotary motions in different directions, which prevents them from being affected by a blow to open the lock, and further, in their being so constructed as to pass each other where the key enters, and thereby cut off all pos sibility of a pick being used to open the lock."

---

13. For an *Improvement in Setting Teeth;* M. S. Foster, Trenton, Mercer county, New Jersey, November 12.

The patentee says,—"The nature of my invention consists in soldering a strip of gold or silver, of the thickness of a half-worn sixpence, and an eighth of an inch in width, more or less, to the outer edges of the superior and inferior plates of gold or silver, designed and prepared to have incorruptible teeth, with artificial gums, fastened upon them; which teeth are usually made in three sections to each plate for whole sets, but varying with some dentists, from a single tooth, to two, making seven sections to each plate when completed."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is constructing the plate upon which the artificial teeth, with gums, are to be fastened, with the flange or turned edge, for the purpose of adding strength to the arch, and preventing the introduction of secretions between the joints."

---

14. For an *Improvement in rendering Metallic Roofs Water Tight around the chimney and dormer windows;* Jno. U. Boesch, Charleston, South Carolina, November 12.

The patentee says,—"To render the joint at the junction of the roof with the chimney, dormer window, or other projection, secure against leaking, take a sheet of copper, or of whatever metal the roof is to be composed, longer than the width of the chimney, and turn up the edge next the chimney, about 8 or 10 inches, more or less, so that the surface shall be parallel with the outer surface of the chimney; then turn up the ends of the sheets at right angles to the roof; then lap the part of the sheet that folds at the corners, against the first described

turned up edge, or against the side of the chimney as specified, and secure the same."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of rendering the joints at the junction of the sheets of metal, secure against leaking around the chimneys and dormer windows, by bending and scolloping the sheets, in combination with the double lapping of the joints as described."

---

15. For an *Improvement in Stoves;* Philetus Phillips, Middletown Point, Monmouth county, New Jersey, November 12.

Claim.—"What I claim as new, and desire to secure by letters patent, is the manner of constructing the hearth or bottom of the fire chamber, having, for the purpose of compressing and strengthening the draught, and bringing it more immediately in contact with the ignited fuel, an aperture, or apertures, extending nearly or quite through the middle thereof, lengthwise of the wood to be placed thereon, having on one or both sides of said aperture, or apertures, a space for the retention of the ashes, to preserve the coals for the renewing of the fire.

"I claim also, in combination with said aperture, or apertures, the inclination of the hearth on the side or sides thereof, to give the fuel and ashes a tendency thereto, and to bring the greatest bulk or depth of fuel directly over said aperture or apertures.

"I claim also, the method herein described, of making the upper section of the fire-brick, or other lining, having an aperture, or apertures, in the top of it, for the direct upward passage of the heated air and smoke, connected with a damper, or valve, to close said aperture, or apertures, to cause the heated air to pass out at the lower edge of said upper section. I claim also, the connexion of said lower edge of the upper lining with the fire-brick, or other material, forming the lower section or hearth, in such a manner as to leave a space of half an inch, more or less, between them for the outward passage of the smoke and heated air.

"I also claim the method herein set forth, of directing the draught downwards, by a plate or plates of cast iron, or other material, of cylindrical or other form, closely connected with said lower edge of the upper lining, to prevent the upward passage of the smoke and heated air, on coming to said edge, and to cause it to descend and pass from within said plate, or plates, near the lower part of the stove, and rise to the upper part thereof, between the lining and the material forming the outer surface of the stove.

"I also claim the exterior and lining of the stove, such as to cause the smoke and heated air, after leaving the chamber of combustion within the lining, to be formed into a thin stratum between them, that the heat may be thus the better radiated, as it rises to the upper part of the stove.

"I also claim the method of employing a lining of fire-brick, or other similar material, in respect to its properties as a non-conductor of heat, serving to form a passage for a stratum of heated air, as described.

"I also claim the combination of a door, designed, when shut, to

exclude the air as much as may be, with the aperture, or apertures, in the hearth as aforesaid, and a drawer underneath, to receive the ashes, and to regulate the admission of air for the purpose of combustion.

"I also claim the connexion of a series of apertures in the upper part of the lining, for the vertically upward passage of the smoke and heated air, extending in the direction of the aperture, or apertures, in the hearth as aforesaid, with a damper or valve having corresponding apertures, and which, being drawn or pushed in a right line, will open or close them all at once."

---

16. For an *Improvement in a Machine to be used in combination with improved iron truss hoops, in the manufacture of barrels, and other coopers' ware;* J. H. Bruner and R. M. Thompson, Granville, Knox county, Ohio, November 12.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the combining the inner frame, having rollers to receive and support the barrel, with the outer frame, by hinging one end of it to said outer frame, and suspending the other to the eccentric, for the purpose and in the manner described. We likewise claim the manner of combining and arranging the respective parts of the holder, consisting of its spindle, bow, revolving shaft, screw points, and sliding head, the whole being formed, and operating substantially as set forth. And lastly, we claim the employment, in combination with said machine, of iron truss hoops, made perfectly true within and without, and of such strength as to enable them to give their own curvature to the ends of the staves."

---

17. For an *Improvement in Shingle Machines;* William Foster, Detroit, Wayne county, Michigan, November 21.

Claim.—"What I claim as new, and desire to secure by letters patent, is the manner in which I regulate the throats of the knives, or cutters, and the thickness of the shingles, by means of circular gauges let into grooves in the table, and the straight bar to which they are connected; the circular gauges being held in place and adjusted by set screws, and serving as ways to sustain the bolts or blocks, the whole being formed and operating substantially as herein set forth."

---

18. For an *Improvement in Lard Lamps;* John Lee, Wellsville, Columbiana county, Ohio, November 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the inner tube and piston, with the outer tube, constructed and arranged in the manner, and for the purpose herein set forth."

---

19. For an *Improvement in Purifying Animal Oils;* Alfred Traband, City of New York, November 21.

Claim.—"What I claim as my discovery, and desire to secure by

letters patent, is the mode of purifying animal oils, by means of the bi-chloride of mercury."

---

20. For an *Improvement in Veneering Machines;* Casper Kittinger, assignor to William Iba, East Grenville, Ohio, November 21.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the method of forming a bed, on which to veneer curved surfaces, by means of slats provided with slots, through which clamp screws pass, to secure them in any position, by which the operator can adapt them to any desired curve, for the purpose and in the manner substantially as herein set forth."

---

21. For an *Improvement in Tuyere Irons;* Richard Brewer, Plymouth, Richland county, Ohio, November 21.

The patentee says,—"The nature of my invention consists in forming my air box into three divisions, which I designate by the names of upper, lower, and back chambers. I connect these chambers with each other in such a manner as to produce a double re-action in the box, before it is allowed to escape to the fire."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the construction of my air box into three chambers, connected with tubes, in the manner and for the purpose herein set forth."

---

22. For an *Improvement in Cisterns for preventing water from freezing;* Joshua Woodward, Naverille, Grafton county, New Hampshire, November 21.

The patentee says,—"The principle upon which I proceed, in preventing the water supplied from freezing is, that the exhalations of air and vapor, which emanate from the ground at the depth of four or five feet, more or less, below the surface, according to the location, is at a temperature some degrees above the freezing point, and that such exhalation may be applied to the preserving of a corresponding temperature in a vessel containing water, and thus prevent its freezing."

Claim.—"What I claim as new, and desire to secure by letters patent, is the taking advantage of the temperature of the earth below the point of frost, and the temperature of the air or vapor emanating therefrom, by making an excavation in the ground, to a depth greater than that to which its temperature may at any time be reduced, to the freezing point, by covering said excavation as described, and by diverting and governing the emanation from the ground, so as to cause it to surround the water which is to be kept from freezing; the whole being effected by an arrangement of the respective parts of the apparatus or structure, substantially the same with that herein set forth and made known."

23. For an *Improvement in Boots and Shoes;* Joshua S. Bowler, Lynn, Essex county, Massachusetts, November 21.

The patentee says,—"This invention or improvement consists in combining and arranging three steel plates, or springs, between the soles of the shank of the boot or shoe, being of the same curvature of the soles, but of less size, each one being smaller than the next above, the plate next the inner sole being the largest, and the plate next the outer sole being the smallest, and the middle plate being of an intermediate size, and all of them being fastened together at the heel by a screw and rivets, and separated at the ends next the ball of the boot or shoe, where all the ends have a longitudinal play between the sole, the side or lateral movement being prevented by forming a projection or stud on each plate, and making corresponding mortises in the plates into which the studs enter."

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of the countersunk screw heel plate with the combined spring shank, constructed and arranged as herein described."

---

24. For an *Improvement in Machinery for shaping the inner side or periphery of the felloes of carriage wheels;* Robert H. Henry, Barre, Worcester county, Massachusetts, November 21.

Claim.—"I claim the method of presenting the inner surface of the felloe section to the proper operation of the rotary curved knife—that is to say, by raising and depressing the curved carriage, during its progressive motion forward or under the cutting knife, by means of projections from the sides of said carriage, and grooves in the stationary side guiding plates, in which said projections move; the whole being arranged and operating substantially as described."

---

25. For an *Improvement in Bee Hives;* E. Booth, Springfield, Massachusetts, November 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the peculiar manner of raising, lowering, and supporting the hive, by means of the hinges and pegs as set forth."

---

26. For an *Improvement in Coal Sifters;* John J. Doane and W. H. Denny, City of New York, November 28.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the peculiar arrangement of the cylinders, in the form of a frustrum of a cone, in combination with the hopper, and the arrangement of the drawers, the whole combined substantially as set forth."

---

27. For an *Improvement in Bee Hives;* Aaron Francis and John Carlisle, Chandlerville, Muskingum county, Ohio, November 28.

Claim.—"What we claim as our invention, and desire to secure by

letters patent, is making a bee hive with a vertical passage in the middle, communicating with the interior of the double ranges of rhomboidal sliding boxes, or bee drawers, for the passage of the bee thereto, for a free ventilation, and for preventing the entrance of moths, &c., in combination with the upper box, and the double inclined plane, ledge, or rest, as described."

---

28. For an *Improvement in Hemp Machines;* J. C., G. W., & C. E. Geisendorff, Cincinnati, Hamilton county, Ohio, November 28.

Claim.—"What we claim as our invention, and desire to secure by letters patent, is the breast board, against which the hemp, &c., is borne when the beaters are in action, in combination with the feeding and discharging rollers as described."

---

29. For an *Improvement in Steering Wheels;* Philip T. Share, Baltimore, Maryland, November 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination and arrangement of the parts, consisting of the steering wheel, and its shaft and cog wheels, and the drums, and the gearing to drive them in different directions; and the construction of the tiller, all as described."

---

30. For an *Improvement in the Self-Acting Brake for Inclined Planes;* Nathan Smith, Waterloo, Sussex county, New Jersey, November 28.

Claim.—"What I claim as my invention, and desire to secure by letters patent, is the combination of a weight or spring, supported by the back chain, when in action, with the brakes of a car, in the manner and for the purpose set forth."

MECHANICS, PHYSICS, AND CHEMISTRY.

Translated for the Journal of the Franklin Institute.

Account of the Experiments to determine the Principal Laws and Numerical Data, which enter into the Calculation of Steam Engines. By M. V. Regnault.

SEVENTH MEMOIR.

On the Compressibility of Liquids, and particularly that of Mercury.

(Continued from page 264.)

In the experiments related in the preceding memoir, it was necessary to know the compressibility of mercury, for the purpose of applying the necessary corrections to the apparent results; but there is very great uncertainty as to the proper numerical value of this quan-

tity, and it appeared to M. Regnault, that the methods heretofore employed for the purpose of determining the compressibility of liquids, could be notably improved by making use of the apparatus which he had at his disposition.

The philosophers who have most successfully investigated this subject, are MM. Œrsted, Colladon and Sturm, and G. Aimé. The method employed by them consists, essentially, in placing the liquid to be examined in a kind of thermometer, with a reservoir of very great capacity, terminated by a capillary stem, open at top, and carrying divisions whose value is known in terms of the capacity of the reservoir. This apparatus, which has been called a *piezometer*, is placed in a glass vessel with very thick walls, which could be put in communication with an air pump, and with a compressed air manometer. (Pressure gauge.) This outer vessel being filled with water, the pressure which is brought upon its surface, is transmitted equally both to the inside and outside of the piezometer, and the liquid sinks in the graduated stem. This sinking shews, however, only the apparent compressibility of the liquid, and it will be equal to the absolute compressibility, only if the piezometer experiences no change of internal capacity, from the effects of the external and internal pressures. M. Œrsted contends that this change is insensible, and can arise only from the thinning of the walls. The mathematical calculation leads to very different results. Poisson (*Annales de Chimie et de Physique, 2me serie, tome* xxxviii, *p.* 330) has deduced from his investigations of elasticity, the formulæ which apply to the case of a spherical reservoir of known diameter and thickness. He has also shewn that, if we designate by a the elongation which a cylinder of any homogeneous material experiences, when one of its bases is fixed, and the other is drawn in the direction of its length, by a force P upon each unit of its surface, the cubical compression k which the same cylinder experiences, when its whole surface is submitted to the pressure P upon each unit of surface, is represented by the formula

$$k = \frac{3}{2}a.$$

Physical philosophers have generally adopted the deductions of the mathematical calculation, and assumed that the change of capacity which the piezometer experiences, is the same as that of a mass of glass having exactly the form of the enclosed liquid, under the same pressure; so that, to obtain the actual compressibility of the liquid, there must be added to the apparent compressibility the quantity $\frac{3}{2}a\ V$, V representing the interior capacity of the piezometer. M. Œrsted has endeavored to show the inaccuracy of the mathematical deductions, by determining, experimentally, the compressibility of water in two reservoirs formed by substances of very different extensibility, viz: glass and lead. The compressibilities appearing but little different in the two cases, M. Œrsted concludes that the correction given by mathematical analysis is not correct, and that this correction may be neglected when the walls of the piezometer have but little thickness.

MM. Colladon and Sturm assumed, in their calculations, that the coefficient of the cubic compressibility of the envelope, was equal to three times the coefficient of the linear elongation which is produced upon a rod of the same metal, by a traction equal, upon each unit of surface, to the pressure which is exerted upon the unit of surface of the piezometer. (*Ann. de Chim. et de Phys., 2me serie, tom.* xxxvi, *pp.* 113 & 225.) M. G. Aimé (*Ann. de Chim. et de Phys., 3me serie, tom.* viii, *p.* 257) employed a piezometer founded upon the same principles, but in place of producing the pressure by a forcing pump, he made use of the natural pressures which are obtained by lowering the apparatus in the sea. He thus obtained pressures much greater than those obtained by other experimenters. M. Aimé calculates the change of capacity of the piezometer, by the formula of M. Poisson.

It cannot be concealed that mathematical formulæ, like that which we are now considering, present great uncertainty, owing to the hypotheses which have to be adopted as to the molecular forces, in order to establish the differential equation of the problem. These hypotheses are probably very far from the truth. Thus mathematicians assume, that the molecules of a solid body move with equal ease in all directions, and that an equal displacement, no matter in what direction, always developes an equal reaction. This proposition is certainly incorrect, even in bodies of confused crystallization. It is very probable that a solid body experiences very unequal resistances in its displacements in different directions. We may, to a certain extent, consider these molecules as forming articulated systems, each system taking the motion easiest for it, when a pressure brought upon the external surface of the body, destroys the molecular equilibrium. It is, then, very desirable that direct experiment should be called in to decide as to the accuracy of the mathematical formulæ.

Besides, even supposing the formulæ irreproachable, there will still remain much uncertainty, on account of the manner in which the coefficient of compressibility (k) of the envelope is ordinarily determined. This coefficient is obtained by measuring the elongation which a glass rod of known length and cross-section undergoes, when it is submitted to a given traction. It is difficult to be certain that the glass rod used for the experiment, is of the same kind as the tube which forms the reservoir of the piezometer; and even if the two specimens of glass came from the same pot, we must still admit that the coefficient (k) is the same in the solid rod as in the tube with thin walls—that it is the same in the longitudinal as in the transverse direction: in a word, the glass must be supposed perfectly homogeneous in all directions, and not affected in an unequal way, by the working to which it has been submitted.

The experiments which have hitherto been made, by different physical philosophers, upon the elasticity of glass, have given very different numbers; which proves that this elasticity varies considerably with the nature of the glass. Designating by P the pressure upon a square millimetre, by a the elastic elongation by metre, expressed in millimetres, by q what has been called the *coefficient of elasticity*, we have, by the definition, $q = \frac{P}{a}$.

The following values have been found for q, for a when P is equal to one atmosphere, and for the cubic compressibility calculated by the formula $k=\frac{3}{2}a$.

		q	a ($P=0_k{\cdot}010298$)	k
	Colladon & Sturm,	10000	0·0000010298	0·0000015447
	Savart,	6009 to 6055	0·0000017137 0·0000017007	0·0000025705 0·0000025510
Wertheim & Chevandier.	Window glass from St Quirin,	7917	0·0000013008	0·0000019512
	Plate glass from Cirey,	7015	0·0000014680	0·0000022020
	Table glass from Valeristhal,	6890	0·0000014946	0·0000022419
	White flint glass from Baccarat,	5477	0·0000018822	0·0000028233

But it is easy to arrange the experiment so that it shall give, at the same time, both the compressibility of the liquid, and that of the envelope which encloses it.

The vessel, *BCD*, (plate V. fig. 1,) within which the pressure is to be exercised, is a copper cylinder, of 12 centimetres diameter, 40 centimetres height, and 2 millimetres thickness of wall. This vessel is closed by a cover of 1 centim. thick, fastened, by a red lead joint, to a collar soldered to the vessel. The cover carries three tubulures; into the central one ($c\,c'$) the graduated stem of the piezometer, A, is cemented, and the other two are closed by stop-cocks. Upon the stop-cock R is tightly fastened a lead tube ($e\,f\,g\,h$) leading to a large reservoir, in which air is compressed by means of a forcing pump. The lead tube ($g\,h$) is bifurcated at g; its second branch ($g\,k$) has a brass end inserted into the top of the stem of the piezometer, and carrying two stop-cocks, one of which (R''') opens or closes the communication with the piezometer, and the other (R'') opens into the atmospheric air. The vessel, *BCD*, is filled with water, and kept in another larger vessel, *MN*, also filled with water, which prevents the temperature of the piezometer from changing sensibly during the experiment. The following is the method of operating:—

First Period.—The reservoir being filled with air, under a pressure measured exactly by the open tube pressure-gauge, (described in the last memoir,) the stop-cocks R and R''' are shut, the stop-cocks R' and R'' opened; the piezometer is then submitted, both internally and externally, to the pressure of the atmosphere. The position of the extremity of the column in the graduated tube is noted—suppose it corresponds to m divisions.

Second Period.—The stop-cock R' is closed, and R opened; the pressure of the air reservoir is now exerted in the vessel *BCD*. The

piezometer then supports on its exterior, the pressure of the air in the reservoir, (P,) while its interior sustains only the pressure of the atmosphere (p). The capacity of the reservoir diminishes under the excess of external pressure, and the liquid rises to m' in the graduated tube. Thus $m'—m$ represents the decrease of cubic content of the piezometer, under the pressure $P—p$.

Third Period.—R' remaining closed and R open, R'' is closed and R''' opened. The piezometer now sustains the pressure P both on its outside and on its inside; the liquid column descends and stands at m'' in the graduated tubes;—$m—m''$ then represents the apparent contraction of the liquid.

Fourth Period.—R is closed, and R' opened; the pressure P is kept up in the interior of the piezometer, while its exterior bears only the pressure of the atmosphere; the liquid column descends to m''', and the effect produced is measured by $m—m'''$.

Fifth Period.—R''' being closed, and R'' opened, the piezometer is again subjected to the atmospheric pressure only, and if it has not sustained any permanent alteration of capacity, the contained liquid should rise again to m. This was found to be very generally the case, and when, owing to a slight change of temperature, it was not strictly so, the difference was so small, that the mean of the first and last observations was taken as the value of m.

By this method of operating we obtain three observations, which give three equations between the unknown quantities μ and k. We may then, by their means, determine both these quantities, and there remains an equation of condition, which may serve to test some of the consequences deduced from the mathematical formulæ.

The use of an atmosphere of compressed air to develope the pressure, presents great advantages over the compression by means of a forcing pump, because the pressures are then perfectly constant, and may be measured with great precision. By opening the stop-cocks slowly, the pressures are changed gradually, which is indispensable, for sudden variations of the pressure often produce permanent changes in the cubic content of the piezometer. At the request of M. Regnault, M. Lamé, who has paid much attention to the mathematical study of elasticity, deduced from the equations the following formulæ, applicable,

1st, To the case of a spherical reservoir,—

$$kP=\frac{1}{V}\frac{4\omega'}{9(N+1)},\quad \mu P=\frac{1}{V}\left(\omega''+\frac{4\omega'}{9(N+1)}\right),\qquad \omega''=\omega—\omega'.$$

2d, To the case of a hollow cylinder terminated by plane bases,—

$$kP=\frac{1}{U}\cdot\frac{3\lambda'}{8(M+1)},\quad \mu P=\frac{1}{U}\left(\lambda''+\frac{3\lambda'}{8(M+1)}\right),\qquad \lambda''=\lambda—\lambda'.$$

3d, To the case of a hollow cylinder with hemispherical ends,—

$$kP=\frac{\theta'}{\frac{8}{3}(M+1)U+\frac{9}{4}(N+1)V},$$

$$\mu P=\frac{\theta''}{U+V}\cdot+\frac{\theta'}{\frac{8}{3}(M+1)U+\frac{9}{4}(N+1)V},\qquad \theta''=\theta—\theta'.$$

In which equations,—

k represents the cubic compressibility of the solid matter of the reservoir, referred to the units of volume and of pressure.

P, The excess of the internal over the external pressure.

$V, = \frac{4}{3}\pi R^3$, the cubic content of the spherical portion of the reservoir, when under the atmospheric pressure internally and externally.

N, The ratio of V to the solid content of the spherical portion of the reservoir.

ω, The apparent diminution of the volume (V) of the liquid under the pressure P.

ω', The apparent increase in the bulk of the liquid, when the pressure P is exerted from without inwards.

ω'', The apparent diminution of the volume of the liquid, when the pressure P is exerted both externally and internally.

U, The cubic content of the cylindrical portion of the reservoir, when submitted to the atmospheric pressure, both inwardly and outwardly.

M, The ratio of U to the bulk of its solid envelope.

$\lambda, \lambda', \lambda''$, correspond in the cylinder, to ω, ω', and ω'' in the sphere.

$\theta, \theta', \theta''$, correspond in the cylinder with hemispherical ends, to $\omega, \omega,'$ and ω'' in the sphere.

μ, The cubic compressibility of the contained liquid, referred like k, to the unit of volume and pressure.

M. Regnault tried three series of experiments on the compressibility of water, in spherical piezometers of copper, and of brass, and in a cylindrical one of common glass.

The following are the results of these three series:—

Table of the Compressibility of Water.

	Extreme pressures in Atmospheres.	Apparent Compressibility.	Compressibilities calculated by Lamé's formulæ.	
			Water. μ	Reservoir. k
Spherical copper reservoir. Mean of 24 experiments,	From 2·8033 to 7·8220	0·000046392	0·000047709	0·000001317
Spherical brass reservoir, Mean of 46 experiments,	From 1·5542 to 9·1206	0·000046847	0·000048288	0·000001440
Cylindrical glass reservoir, Mean of 36 experiments.	From 2·5387 to 10·3528	0·000044304	0·000046677	0·000002368

In the first series, there was remarked a regular decrease of the coefficient of compressibility as the pressures increased; as, however, this did not shew itself in either of the other series, and as the coefficients of compressibility of the metal (k) were irregular, this apparent decrease was probably due to permanent changes of capacity in the reservoir, the metal of which is soft, and but slightly elastic.

The coefficient k, obtained in these experiments, is less than that deduced from the measurement of elongation by the formula,

$$k = \frac{3}{2}a.$$

The different values of the means for the apparent compressibility, varying more than can be attributed to errors of observation, show, in M. Regnault's opinion, that M. Œrsted was in error, in supposing that the change in the capacity of the piezometer, during the experiments, might be neglected; while the differences of value for the absolute compressibility, which, though smaller, are still without the limits of errors of observation, show, either that the formulæ do not exactly represent the phenomena, or that the experiments are far from realizing the conditions admitted in their establishment.

Experiments on the Compressibility of Mercury.

The determination of the compressibility of Mercury was the principal object of these researches. The piezometer employed was the glass one used in the experiments with water. The method of operating was exactly the same. The following table, which we copy entire, contains the results of these experiments.

Compressibility of Mercury in a Cylindrical Glass Piezometer.

PRESSURES.		ACTION.					Compressibilities Calculated by Lame's Formula.	
In millimetres.	In Atmospheres.	External. α'	External and Internal. α''	Internal. α	$\alpha'+\alpha''$	Apparent Compressibility δ	Mercury. μ	Glass. k
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
2535·98	3·3368	10·150	0·450	10·450	10·60	0·000001270	0·000003670	0·000002400
2534·36	3·3347	10·150	0·450	10·450	10·60	0·000001270	0·000003670	0·000002400
2533·72	3·3338	10·150	0·350	10·300	10·50	0·000000990	0·000003390	0·000002400
2531·82	3·3326	10·100	0·500	10·400	10·60	0·000001410	0·000003790	0·000002390
2530·22	3·3292	10·100	0·400	10·300	10·50	0·000001130	0·000003520	0·000002390
4262·62	5·6087	17·050	0·650	17·450	17·70	0·000001090	0·000003490	0·000002400
4255·65	5·5995	16·875	0·725	17·625	17·60	0·000001220	0·000003600	0·000002380
4251·55	5·5941	16·950	0·700	17·450	17·65	0·000001170	0·000003550	0·000002380
4225·48	5·5598	16·600	0·800	17·450	17·40	0·000001350	0·000003710	0·000002360
4217·67	5·5495	16·600	0·700	17·050	17·30	0·000001180	0·000003540	0·000002360
4209·66	5·5390	16·650	0·550	17·050	17·20	0·000000930	0·000003300	0·000002370
5394·29	7·0978	21·250	0·850	22·050	22·10	0·000001120	0·000003480	0·000002360
5381·92	7·0815	21·200	0·900	21·900	22·10	0·000001190	0·000003550	0·000002360
5372·61	7·0692	21·100	0·850	21·850	21·95	0·000001130	0·000003490	0·000002360
5361·94	7·0549	21·075	0·825	21·775	21·90	0·000001100	0·000003460	0·000002360
6756·05	8·8895	26·500	1·100	27·500	27·60	0·000001160	0·000003520	0·000002360
6741·24	8·8832	26·550	1·050	27·450	27·60	0·000001110	0·000003470	0·000002360
6715·90	8·8367	26·550	1·000	27·300	27·55	0·000001090	0·000003420	0·000002360
7300·25	9·6056	28·800	1·100	29·750	29·90	0·000001080	0·000003450	0·000002370
7281·80	9·5813	28·750	1·050	29·650	29·80	0·000001030	0·000003400	0·000002370
7266·78	9·5615	28·700	1·100	29·600	29·80	0·000001080	0·000003450	0·000002370
7251·05	9·5408	28·650	1·100	29·550	29·75	0·000001080	0·000003450	0·000002370
					Means,	0·000001234	0·000003517	0·000002374

The values of k, the compressibility of the glass envelope, are exactly the same as those found in the experiments upon water, which

is a proof of the accuracy of the observations. The apparent compressibility of mercury in glass is extremely small, which makes its accurate determination very difficult; so that we see that, in column 7, the variations are considerable, when compared with the absolute value of the quantity to be determined.

The absolute compressibility $\mu = 0{\cdot}000003517$ necessarily presents a little uncertainty, arising from the correction which should be applied for the change of capacity of the envelope. The compressibility of mercury, under a pressure equal to the weight of a column of one metre of mercury, is $\mu' = 0{\cdot}000004628$.

On the Heat Developed by the Compression of Water.

Numerous experiments, carefully conducted, shewed that the heat developed by a sudden pressure of 10 atmospheres upon water, was not able to raise its temperature $\frac{1}{30}$th of a degree centigrade. This quantity, therefore, wherever it occurs, may be neglected.

(To be Continued.)

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Explosion of the Steam Packet Concordia.

NEW ORLEANS, Sept. 23, 1848.

Gentlemen:—I send you sketches of the appearance of the boilers of the steam packet Concordia, taken the next day after their explosion, and before any change had taken place in their position among the ruins. The explosion of the boilers, (they were 30 feet long, 40 inches diameter, with two 15-inch flues,) took place about 5 o'clock, A. M., on the 17th of September, 33 miles above this city, at, or near, the town of Plaquemine. There are contradictory statements on this head, some accounts being that she was at the landing, and others, that she was half a mile off, racing. This I have not taken any pains to correct, preferring to come to my own conclusions, by a critical examination of the boilers, which tell the truth for themselves. *The cause was a deficiency of water.*

I will now enter into a description of the sketches, premising that the view was taken from the boiler deck of an adjoining steamboat, and gives the correct position of the boilers and fragments, excluding al that is not connected with the exploded boilers. The two starboard boilers are not much injured, being only displaced a little.

Fig. 1, is the larboard outside boiler, which was carried 16 feet astern of its bed, and lays on the main deck.

Fig. 2, is the next inside. The after end is nearly in its place, the boiler being partly on its side. The forward end has been thrown about 7 feet sideways, towards the guards.

The flue, *a*, is collapsed, except a very small portion of the after end; a piece of the forward end, a^1, being torn off. This piece of the flue is also separated from the parts of the head, fig. 4, and is of cylindrical form;—an indentation and crack is formed by its coming in contact

with something solid. At *b*, the flue is nearly asunder, (see the enlarged view, fig. 3.) This cracked part is very bad iron, much laminated, showing imperfect welds, and has a very rotten appearance,—the same may be said of the end torn from the after head. This flue has evidently been red hot, and the collapsing pressure was so great, that the internal heads of the rivets can all be counted outside, having indented the sheets, and each rivet forming a projection on the plane outer surface.

The flue *c*, in the same boiler, has its cylindrical form, and has not the appearance of having been much over-heated; a fragment of the cast iron front head is still on it. *d* shows part of the shell, it being nearly vertical. *e* is the other part of the shell, partly turned down. *f* is part of the steam drum, with a piece of the steam pipe attached. It stands nearly perpendicular, its head resting on the bent part of *e*.

Fig. 4, is part of the shell torn from the end of fig. 2. It is doubled up, and is nearly flat; one chock joint still hangs to it. *g g g* shows fragments of the cast iron head still attached to the sheets.

Fig. 5, is part of the shell that has been stripped off of fig. 1, at *h*. It presents nearly a plane surface, and its nearest edge to the end of the boiler, fig. 1, is 10 feet, measured diagonally on the main deck.—This presents the most remarkable feature of this explosion. I have seen the remains of many exploded boilers, but never any thing similar to this. The flues are perfectly good, and the remaining part of the shell is as it was before, except some slight indentations caused by the unequal surface it fell on.

A very small portion of the fractures of the shell follow the line of the rivets, the tears being through the solid parts of the sheets. With the exception of the flue *a*, the iron is of good quality, the clean fractures presenting the appearance of tough iron, and it is of the usual thickness. The boilers are said to be five years old; if so, they have no indications of that age.

The water-line in each boiler is well defined. Commencing with the starboard one, it is one inch above the level of the flues; the next one to it is two inches above the flues; the next being the boiler fig. 2, the highest water-line is quite one inch *below* the tops of the flues, and in the outside boiler, fig. 1, it is about half an inch below the flue tops.

There must have been some obstruction in the standing pipes, through which the water is forced into each boiler, to account for the unequal height of the water-lines; or it is possible that, from some cause, more heat was applied to these two boilers, thereby generating a greater quantity of steam, which, not escaping freely into the other boilers, the excess of pressure on the surface of the water, forced it into that which had the highest water line.*

The collapsing of the flue *a*, I believe to be the origin of the explosion—the part at the head of fig. 2, and the gap at the after end, occur-

* I once had charge of three cylinder boilers, (the fuel being coal,) in which there was a regular ebb and flow. Sometimes all the water would be in one outside boiler, and then it would pass to the other outside one. The rise of the surface of the water, in either of the boilers, could be made at pleasure, simply by opening the fire-door under that boiler.

ing at the same instant of time, the outside boiler following. The breeches and lower part of the larboard chimney, being carried away so suddenly that the upper part of the chimney descended perpendicularly, and the starboard chimney falling over it, presents the appearance, (looking from the bow,) as shown by fig. 6.

The force of the explosion was upwards, carrying away part of the boiler deck, and also the hurricane deck, or roof, just forward of the pilot's house—the breach measuring about 28 feet fore and aft, and being clear across the boat.

The doctor,* which is immediately behind the boilers, is very little injured.

Six persons were killed outright, and six or eight, including the captain and engineer, were badly scalded; two of these have since died.

Many engineers on this river (and this is a marked instance) are in the habit of carrying low water, under the erroneous impression that more steam can be generated by so doing—which I know to be false, for I have made many experiments to test that matter, during the last sixteen years, and invariably found that more power could be obtained from high water—and this leads to explosions if the least derangement takes place to prevent the supply; or, what is worse, throwing a large body of water, of low temperature, into the overheated boiler.

It is said that a committee of engineers are to be appointed, to examine into the causes of this explosion. If any additional information is produced by their report, I will forward it to you, so that it may be incorporated with this.

Respectfully yours, A. C. Jones.

New Orleans, October 2, 1848.

Enclosed is the report of the Committee of Engineers, inquiring into the causes of the explosion on board the steamer Concordia, a description and sketch of which I forwarded to you under cover. This report throws no additional light on the subject, but confirms my opinion of the cause,—my examination having been prior to theirs.

I have seen a counter report, drawn up by friends of the engineer, which, in my opinion, is calculated to do him more harm than good. Their examination took place some time after the others, and, of course, the appearance of things was changed. I will state that I have no connexion with either party, having made my examination, on the arrival of the boat, on my own hook.

Respectfully, A. C. Jones.

Meeting of Engineers on board Steamboat Concordia.

In accordance with the request of Captains Pease and Thomasson, a number of practical and scientific engineers, (being about twenty-

* As Northern readers may not understand this term, I will state that it is the name of the supplemental engine, used for pumping water into the boilers—pumping the water out of the hold—and acting as a fire engine in time of need.

three,) convened on board said boat, lying opposite New Orleans, to examine the causes that led to the late disaster on board said boat.

After a thorough examination of the exploded boilers, the meeting was called to order, by the selection of Mr. Daniel Blair as President, and H. C. Vontagen and John F. Hunt, as Secretaries. Whereupon, the following committee was selected to report upon the causes of the disaster:—Edward Grinnell, Daniel Blair, James Armstrong, John F. Hunt, Mr. Longmaker, H. Conduit, Mr. Lupton, Mr. McFarland, Mr. Douglass, H. C. Vontagen, and Mr. Murrey.

After mature deliberation, and hearing evidence, adduced before the committee, they reported as follows, which was unanimously adopted.

DANIEL BLAIR, *President.*

H. C. VONTAGEN, JNO. F. HUNT, } *Secretaries.*

Report of the Committee.

Whereas, the steamboat Concordia, Capt. Horace Fease, left New Orleans on Saturday evening, the 16th instant, on her customary trip for Millikin's Bend, and having proceeded without accident, till about half a mile above Plaquemine, about half-past four o'clock, A. M., on the morning of the 17th, the aforesaid boat did explode her two larboard boilers, whereby several of the officers and crew were killed, and others scalded; and whereas, at the instigation of Captains Pease and Thomasson, the undersigned have visited the said steamboat Concordia, for the purpose of investigating the causes of the explosion, and report as follows:—

That, from the appearance of the boilers, there was, at the time of the explosion, a deficiency of water,—though, from evidence adduced, it appears that the second engineer left watch some half hour previous to the accident, and left with an adequate supply of water in the boilers.

That it may be possible that the flues in the larboard boiler were bare of water, in consequence of the boat having been listed to starboard considerably, when leaving Plaquemine, and, when righting up, the water came in contact with the flues, intensely heated by thus being left bare.

And further, that this meeting has seen ample certificates as to the character of the first engineer, who had the misfortune to be on watch at the time of the explosion, and that said certificates are fully sufficient to exempt Captain Pease and owners from all blame in employing him.

EDWARD GRINNELL, *Chairman.*

H. C. VONTAGEN, *Secretary.*

TO THE COMMITTEE ON PUBLICATIONS OF THE JOURNAL OF THE FRANKLIN INSTITUTE.

Leaden Shot and Fowling Pieces.

Of the origin of small leaden, or dropped-shot—perhaps the simplest, and certainly the most purely philosophical, of manufactures—little or

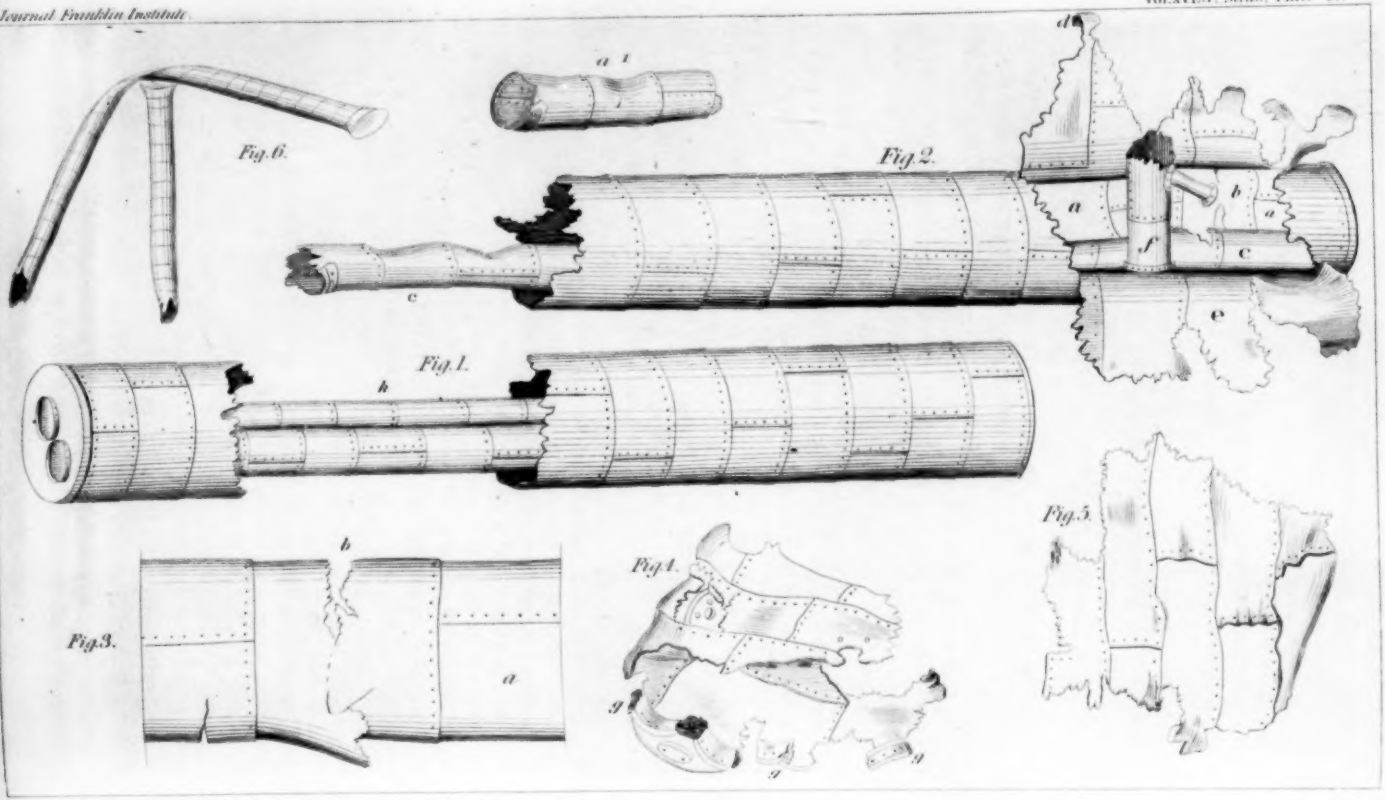


Fig. 6.
a 1
Fig. 2.
d
a
b
a
f
c
c
e
Fig. 1.
h
Fig. 5.
Fig. 3.
b
a
Fig. 4.
g
g
g

nothing is known. This is to be regretted, for a knowledge of the thoughts and circumstances that led to, and attended, its developement, would have been exceedingly interesting.

In other departments of metallurgy, workmen toil, with many tools, to mould, cast, turn, hammer, and file substances into desired forms; but the modern shot-maker, as if soaring in science above his neighbors, as well as operating over their heads, mounts a tower, and listlessly pours his metal into free space, confident that, as it falls, Nature will break and mould it into the form he wants, while he stands looking on. Nor is he disappointed. By the same law that spherules of dew, of hail, and rain, are shaped, shot is made—the law by which the materials of the sun and moon, the globe we inhabit, and all the mightest and minutest orbs, whirling through the heavens, were gathered round their common centres. Of creation's paramount influence, and its operations in space, what more beautiful illustration! The artist imitates his Maker, for of what is the universe composed, but of variously sized shot, dropped from the hands of the Deity?

The facility with which streams of metal are changed, in this way, into spheres, the accuracy of outline, and beauty of finish attainable, are remarkable. But for immediate oxidation, the surface of the globules would be smooth and bright, as those of water or quicksilver. Whether the invention came in with the match-lock from the East, or is a European one, has not, that I am aware of, been ascertained.—Some persons have supposed that Watts, of Bristol, who patented a process for making it in 1782, was the first maker;—a great mistake. His mode differed in nothing from the ancient one, except in dropping the fused metal from greater elevations than had been the previous practice. "For small shot," he says, "*ten* feet, and for the largest, 150 feet, or more." *See Rep. Arts*, III, 1795.

That this missile was an early accompaniment of portable fire-arms is pretty evident; but the date of its appearance, and the name of its author, are under a cloud.

That primitive muskets were devised to kill men, and, for a while, confined to that purpose, is probable, but their application for destroying smaller game was too obvious to be overlooked. Beckman says they were too long and heavy to be fired without a prop, and were *first* used in war at the siege of Parma, in 1521. Not so. Edward IV had 300 Flemings in his service, armed with them, in 1471. They formed part of the armament of Columbus; and further, soldiers are repeatedly figured in the act of firing hand-guns, without rests, and with trigger-locks, taking sight, and handling them like modern troops, in the German translation of Vegetius. (*Enffurt*, 1511.) They appear there as common as artillery, of which greater varities are portrayed than are now in use.

There is a passage in Petrarch's "*Phisicke against Fortune*,"—("Englyshed by Thomas Twynne," Lond. 1579,) which implies that, in his day, they were common. He died in 1374. It occurs in the 48th dialogue, when "Reason," remarking on personal arms, says:—

"A father can leave none other inheritance to his sonne than he hath, to wyt: his bowe and arrowes, his *piece*, his shielde, his swoorde

and wane, and that also which maketh up the game, his golden spurres."

Now *piece* was the old technical name for portable guns; hence, as their varieties increased, arose "Wall Pieces," "Birding Pieces," "Fowling Pieces."

The 99th Dialogue is "On Engines and Artillerie." One passage, though not relating to the special object of this paper, is worth extracting.

"*Joy.*—I have innumerable engines and artillerie.

"*Reason.*—It is marueyle, but thou hast also pellets of brasse, which are throwne foorth with terrible noyse of fire. Thou miserable man, was it not yenough to heare the thunder of the Immortal God from heaven? O, crueltie joyned with pryde. From the earth, also, was sent forth unimitable lightning, with thunder, as Virgil sayth, which the madness of men hath counterfeited to do the like: and that which was woont to be throwne out of the cloudes, is now throwne abrode with a *wooden* [?] instrument, but of a deuylish deuice, which, as some suppose, was inuented by Archimedes, at what tyme Marcellus beseiged Syracuse. Howbeit, he devised it to the extent to defend the libertie of his citizens, and to auoyde or defende the destruction of his country, which you now use to the subiection or subuertion of free people. *This plague of late dayes was but rare*, insomuch as it was behelde with great woonder, but now, as your myndes are apt to learne the worst thyngs, so *it is as common as any other kind of munition.*"

This extract removes all doubt respecting the "*Crakys of War*," alleged to have been employed in 1327, by Edward III, in Scotland, and subsequently at Cresci. Chaucer speaks familiarly, too, of gonnes.

Hand-guns, apparently with match-locks, were in use by English gentlemen and yeomen, under Henry VII, and must have been rather extensively used in fowling, and killing small animals; since a stringent game law, passed in the sixth year of Henry VIII, repeals "former statutes touching shooting with cross-bows and hand-guns," and enacts that whoever keeps in his house, or shoots with, a hand-gun, shall forfeit it, and pay "ten pounds for every shoot," unless he have a yearly income of three hundred marks.

In the 33d year of Henry VIII, fresh regulations were made respecting "hand-guns, hagbuts, or demy-hakes." The former were to be a yard long, the latter three-quarters. The preamble states that people went about with "little short guns, and little hagbuts, furnished with gunpowder, fire, and touch." All persons were prohibited to kill fowl and deer with them, except such persons as were worth, in land, a hundred pounds yearly. One section applies to the *makers* of them. From the expression "fire and touch," it would seem that the flint lock was not then known, or but little known, to British sportsmen.—(See Keble's Statutes at Large, Lond. 1681.)

Up to this time, (1642,) there is no intimation of dropped-shot, and we are left to conjecture what the missiles were which fowlers used. "Half-shot" were in vogue, and they, I suppose, were small bullets or buck-shot. It appears, however, that dropped-shot was known to-

wards the end of the reign of Henry VIII, since it is expressly mentioned, and by its old characteristic name, in a law passed in the second year of Edward VI.

"Whereas, an act was made in the 33d year of the late King of famous memory, Henry the 8th, for some liberty to shoot in hand-guns, haques, and harquebuts; by which act it was provided that no person should shoot in any of the above said pieces, but at a bank of earth, and not at any deer or fowl, unless the party might dispend an hundred pound by the year. Forasmuch as the said act having been devised, as it was then thought, for necessary exercise, tending to the defense of the realm, is grown sithen to the maintenance of much idleness, and to such a liberty, as not only dwelling houses, dove-cotes, and churches, are daily damaged by the abuse thereof, by men of light conversation, *but that also there is grown a customable manner of shooting of* HAIL-SHOT, whereby an infinite sort of fowl is killed, and much game thereby destroyed, to the benefit of no man; whereby, also, the meaning of the said statute is defrauded, for that the said use of *hail-shot* utterly destroyeth the certainty of shooting, which, in wars, is much requisite. Be it therefore enacted, that no person, under the degree of a Lord in Parliament, shall, from henceforth, shoot in any hand gun, within any city or town, at any fowl, or other mark, upon any church, house, or dove-cote. Neither shall any person shoot in any place, *any hail-shot*, or any more pellots than one at one time, upon pain," &c.—that is, a fine of ten pounds for every shot, and three months' imprisonment.

A second section declares the above is not to prejudice the rights of those allowed to shoot by the 33d of Henry VIII—the use of "*hail-shot* excepted, as, indeed, *that kind of shot* in the said act was not meant."—*(Statutes at Large.)*

From the last remark, the inference is, that this shot was introduced into England—if not invented there—between 1542 and 1548.

The objection, that the substitution of a number of shot for a single one, would diminish the previous accuracy of aim, was well taken. It is doubtful whether modern sportsmen equal—they certainly do not surpass—their predecessors in this respect. Shooting game flying, with the bow, was quite common; but the perfection of fowling was to hit a bird on the *bill* so as not to lacerate the body. This was beating the old marksman, who addressed an arrow to Philip's right eye.

In the first of James I, cap. 27—another severe game law—hail-shot is forbidden to be fired from "hand-guns or birding pieces," except by persons duly licensed, and then only to kill "crows, pyes, rooks, ring-doves, jays," &c., "for hawk's-meat only." Here, again, the old hand-gun is a regular fowling piece. When Falstaff proposed to hide himself in the chimney, Mrs. Ford told him that would not do, as "there they always use to discharge their birding pieces." The same hero describes his recruits as starting at the report of a caliver—a sportsman's gun—"worse than a struck fowl, or a hurt wild-duck."

The oldest direction for making hail-shot that has fallen in my way,

dates no further back than the middle of the 17th century. It is professedly copied from previous writings. The essential parts run thus:

"Melt lead down in an iron kettle, skim it, and when 'tis so hot that it begins to turn greenish, strew as much fine powdered auripigmentum (arsenic) upon it as will lie upon a shilling, to every twelve or fifteen pound of lead, which then must be stirred well, and the auripigmentum will flame. A little may be taken out in a ladle for an essay, and which, when reduced to a proper heat, may be dropt into a glass of water. If the drops prove round, and without tails, there is auripigmentum enough therein, and the temper of the heat is as it should be; but if otherwise, more auripigmentum must be added, and the heat augmented till it be found right."

Directions then follow, to pour the metal through a perforated dish in the usual way, and to sort the shot by means of sieves.

The most remarkable part of the direction is the short space the metal fell through. The perforated dish was "placed on two bars, or other iron frame, over a tub of water, about *four inches* from the water." No wonder "the greatest care was to keep the lead at so moderate a heat, that it be not too cool, to stop the holes, nor too hot, which will make the drops crack and fly;—for the cooler it is, the larger the shot will be. Such as will have very large shot, make the lead trickle with a stick, out of the ladle into the water, without a [perforated] plate."

It would be difficult to point out, in the records of the arts, an example of dullness in old workmen, so gross as the history of hail-shot exposes. For about 240 years previous to Watts' improvement, its fabricators dropped it close to the vessel of water prepared to receive it, while every ounce they made, was attended with embarrassments that loudly suggested a greater fall. Had they melted the metal on a second floor, and poured it from the window, an amount of trouble and mortification would have been avoided, which no one, not practically acquainted with its manufacture, can appreciate. I know not how to account for the fact, unless by supposing no manufactory of any consequence was established, to supply the public, and that sportsmen were in the habit of making it for themselves.

That buck or cast shot sometimes went by the name of hail-shot appears evident. In 1594, some English sea rovers, under James Lancaster, took Pernambuco. The writer of the expedition, in Hakluyt, says their muskets were provided with "haile-shot, which severely gauled the Indians and Portuguese." That this was not dropped shot, appears from his next sentence. "And this is to be noted, that there was both the horse and his rider slaine with one of these shot."

E.

Translated for the Journal of the Franklin Institute.

New Metallurgic Treatment of the Ores of Copper. *By* MM. Rivot *and* Phillips.

This process, by means of which the authors have already treated more than 600 lbs. of copper ore, is principally applied to the sulphur-

etted ores. The ore is first roasted, to reduce it, in great part, to the oxide of copper; then melted with silicious materials, to transform it into a silicate; and it is from the melted silicate that the copper is precipitated, by placing in it bars of iron.

When the reverberatory furnace, in which the authors operate, is very hot, they charge it with a mixture of the roasted ore, with lime or sand, and the slag from a former operation, in sufficient quantity to cause the fusion of the mass; they add charcoal, or poor bituminous coal of small size, in proportion to the quantity of the ore treated.—After the charge, one or two shovels-full of small coal is thrown upon the surface, to preserve it from oxidation from the furnace flame. It is also stirred from time to time, so as to permit it to be heated more uniformly, and melted quicker. The authors have succeeded in melting it completely, in four hours. As soon as the matter begins to thicken, the parts which adhere to the stirrer contain a certain quantity of grains of copper. When the fusion is complete, the tools plunged into the bath, shew that the copper is collected at the lower part of the hearth, near the discharge hole.

When the whole is perfectly fused, six bars of iron, weighing together from 70 to 90 pounds, are placed in it, the ends slipping in grooves opposite to the working door, taking care to plunge them entirely in the bath. Some fresh small coal is thrown upon the surface of the cinder, to prevent the peroxidation of the protoxide of iron of the cinder by the flames; then every two hours it is stirred with two-pronged rakes. A powerful method of stirring also consists in the use of a wooden pole, which, plunged into the cinder, gives a considerable disengagement of gas, and produces strong ebullition.

The authors have found, that, in three or four hours, the action of the bars will reduce the content of the cinder to 0·004 to 0·006. After that time the bars are withdrawn, and the metal drawn off.

The entire duration of an operation is, therefore, eight hours, and three operations per day may easily be made.

The loss of weight by the bars, varied, in the experiments of the authors, from 2 to 12 lbs., for quantities of copper from 24 to 44 lbs., obtained from ores of different richness.—*Bull. Soc. Enc. Indus. Nat., May*, 1847, *p.* 248.

Death of Berzelius.

We last week recorded the death of the celebrated Swedish chemist, Berzelius, in the 69th year of his age. He had been for a long time in declining health,—and, although his death will not have taken Europe by surprise, there will be but one feeling of grief for so great a loss. In a century which has produced a greater number of distinguished chemists than, perhaps, of any other class of men of science, Berzelius stood out as a star of the first magnitude. If, perhaps, our younger students of chemistry have, in some measure, lost sight of him, amidst the brilliant researches of modern organic chemists, it must not be forgotten that the patient labors, and sagacious investigations,

of Berzelius, have done more to lay the foundations of organic chemistry, than those of any other chemist. To him, more than to any other man, belongs the honor of applying the great principles which had been established by Dalton, Davy, Wollaston, Gay-Lussac, and himself, in inorganic chemistry, to unfolding the laws which regulate the combinations forming the structures of the animal and vegetable kingdoms.

It is to the honor of Sweden, that Berzelius is only one of a number of her sons, whom the cultivation of natural science has led from poverty and obscurity, to the highest dignities and emoluments bestowed by the State. Of humble parentage, and beginning life with limited resources, the successful cultivation of chemistry procured for him, not only the respect and admiration of the world, but that position and consideration in his own country, which the man of science has a right to claim, and which it is the privilege of sovereigns and states to bestow.

Berzelius was born in the village of Väfversunda, in the canonry of Linkogring, in Ostgothland, on the 29th of August, 1779,—not at Linkagring, on the 20th of August, as is often erroneously stated in the many notices of him. His father kept the parish school in the village where young Berzelius was born, and there he appears to have received his early education. At the age of seventeen, he commenced his studies at the University of Upsala, hoping to qualify himself for the medical profession. At this time, although Sweden could boast of having produced a Bergmann, and a Scheele, the more brilliant genius of Linnæus had given to natural history such an impetus, that chemistry was scarcely regarded by the medical student. It is true that Afzelius, who was a nephew of Bergmann, and then filled the Chemical Chair at Upsala, had performed some very creditable chemical analyses; but his health was bad, and he was assisted by Ekeberg, who, though a skilful analyst, yet wanted the energy and other qualifications for a successful teacher. The lectures on chemistry were read, and no experiments were performed. These unpromising circumstances were scarcely likely to produce a great chemist, but they seem to have developed the genius of Berzelius. Prof. Johnston gives Berzelius's own account of the influences of his situation. The students were allowed to work in the laboratory once a week.

"Berzelius, like the rest, went to the laboratory soon after he had commenced his chemical course, and asked for an operation. The first that was given him, was to form colcothen of vitriol, (crocus mentis,) by heating sulphate of iron in a crucible. 'Well,' says he, 'every servant can do this. If this be all I am to learn, I may as well stay away.'—'Oh, but,' replied Afzelius, 'your next operation will be more difficult.' Accordingly, when he asked for a second operation, he was instructed to prepare caustic potash, by burning cream of tartar in a crucible. 'This so disgusted me,' says Berzelius, 'that I vowed I would never ask for another operation. Still I frequented the laboratory; and, at the end of three weeks, found myself attending regularly every day, though I had no right to do so, and Afzelius could have turned me out, yet I was allowed to return, and operate, and break

much glass,—while Ekeberg, especially, was much annoyed that I never asked a single question.—For,' he adds, 'I liked better to seek for information from reading, and thinking, and experimenting, than from men who, having little experience themselves, gave me, if not evasive, at least unsatisfactory, answers, regarding phenomena they had never themselves observed.' "

In the year 1798, Berzelius passed his philosophical examination, as preparatory to the final one for M. D. At this time he left the University; and in 1799 we find him assistant to a Dr. Hedin, a superintendent physician of the mineral waters of Medevi. The composition of these waters attracted the attention of Berzelius, and his first published essay was a dissertation, in conjunction with Ekeberg, on the mineral waters of Medevi. He underwent the examination for a licence to practice medicine, in 1801, and graduated at Upsal on the 24th of May, 1804. On leaving Upsal, Berzelius repaired to Stockholm, where he became assistant to Andrew Spaurnau, who sailed with Cook, in one of his voyages round the world, and was then professor there of medicine, botany, and chemical pharmacy.—Spaurnau died in 1806,—and Berzelius, by his inaugural dissertation on galvanism, and other papers, had already obtained for himself a sufficient degree of confidence to be appointed his successor. Although this chair embraced a very wide range of subjects, as was frequently the case with Swedish chairs at that time, Berzelius more especially devoted himself to chemistry. It does not appear, indeed, that he gave any lectures on botany, except at the Military College of Carlberg, where he also held an appointment as lecturer. At first he was not more successful in teaching chemistry than his predecessors; but having received a hint from Dr. Marcet, of London, that chemical lectures should be illustrated by experiments, he adopted this plan, and likewise abandoned the old practice of reading lectures. He used to express himself very strongly on the inutility of merely reading lectures. Although he first adopted Dr. Marcet's experiments in his class-room, he soon so far improved upon these, that his own became a model for the chemical class-rooms of Europe.

During the early period of his residence at Stockholm, he practised the profession of medicine, and, in 1807, was mainly instrumental in forming the Medical Society of that capital. In 1810 he was made President of the Royal Academy of Sciences at Stockholm; and, in the same year, received the appointment of Assessor of the Medical College, and was made a member of the Royal Sanitary Board. At this time, though scarcely more than thirty years of age, he had obtained great reputation as a chemist. He had published a work on animal chemistry, containing many original investigations on the fluids of the animal body; and which was subsequently translated—as, indeed, have been most of his works—into almost every language of Europe. In conjunction with Hisinger, he commenced, in 1806, the publication of a periodical work entitled "Afhaudlingar i Fysik, Keim, och Mineralogi," which contained a series of papers by himself, constituting some of the most valuable contributions that had yet been made to analytical chemistry. His labors were regarded as of so much impor-

tance by the Royal Academy of Stockholm, that that body decreed him, in 1811, 200 dollars yearly for his chemical researches. In 1812, Berzelius visited England, where he was most cordially received. In that year he communicated, through Dr. Marcet, a valuable paper to the Medico-Chirurgical Society of London, "On the Composition of the Animal Fluids." In 1818 he visited France and Germany—countries in which he was better known than in Great Britain, as most of his papers and works were published in the languages of those countries, as well as in that of Sweden. In the same year he was appointed Secretary to the Academy of Sciences—a post which he held till his death. In 1831, he was allowed to retire from the active duties of his professorship at the Caroline Institute, but he still held the title of honorary professor. Up to this time he had resided in apartments provided for him, at the building occupied by the Academy of Sciences, —where, on the same floor, he had his study and laboratory, so that he could, with little difficulty, pass from his desk to his crucible, and husband his time to the greatest possible extent. He now, however, moved to a house of his own,—and in 1835 married the daughter of the town-councillor (staats-rathe) Poppius. In 1837 he received the Great Gold Medal of the Royal Academy of Stockholm,—and in 1840 the Diet of Sweden voted him a pension of 2000 dollars per annum. The scientific societies of Europe and America contended for the honor of inrolling his name amongst their members,—and with eighty-eight of these bodies it was connected. Nor was his sovereign, Charles John, behindhand in recognizing the most distinguished of his adopted countrymen. In 1815 Berzelius was made a Knight, and in 1821 a Knight Commander, of the Order of Vasa. In 1829 he received the Grand Cross, and in 1835 was made a Baron. The intelligence of this honor was conveyed to Berzelius by the hand of the King; who wrote himself a letter, intimating his deep sense of the merits of the philosopher, and expressing a hope that, in this nomination, the world would recognise a homage paid to the man who had consecrated his life to those useful researches which had been already recognized by Europe, and which it was the glory of Sweden to be able to appropriate, as the patrimony of one of her children. This letter was sent to Berzelius on his wedding-day. How few men of science have married, with a patent of nobility on the breakfast table! Sweden had, however, yet one more ovation for her beloved son. In 1843 he had been a quarter of a century Secretary to the Academy, and on this occasion a festival was given in his honor. The Crown Prince was in the chair,—and a portrait of the chemist, painted by Lieut. Col. Lodemark, was presented to the Academy.

Such was the calm, unruffled, successful career of the deceased philosopher. Would that the career of every disciple of science were as happy! He who was thus honored, merited it—merited it on account of his unwearied industry, his clear and manly intellect, his noble and amiable disposition. The diligence with which he worked, both in his study, and his laboratory, may be judged of by his systematic works, and original contributions to science. In addition to the works already mentioned, he published a "Manual of Chemistry," which

went through several editions, that of 1841 consisting of 10 volumes, —and, we believe, another larger edition has since been published. In 1822 he commenced the publication of an Annual Report on the Progress of the Physical Sciences, which has been published every year to the present time. These volumes are the most valuable record of chemical research extant, and contain a full report of the discoveries that have made the period to which they relate so remarkable in the history of chemistry. From 1806 to 1818, he published, with Hisinger, the periodical to which we have before alluded; and in these volumes we find forty-seven papers by Berzelius, all giving an account of original researches by himself. In addition to these, he has published works on galvanism, on analytical chemistry, on mineralogy, and a vast number of papers in various Transactions.

The name of Berzelius has been too intimately connected with the history of chemistry, for the last forty years, for us, in this slight sketch, to give an adequate idea of the influence which his discoveries and generalizations have exerted upon the science. To him it is indebted for the discovery of several new elementary bodies,—more especially selenium, morium, and cerium. He first demonstrated the acid nature of silica, and was thus enabled to throw light on the composition of a series of interesting mineral compounds of silica with the metallic oxides. This subsequently led to a whole re-arrangement of mineral bodies, and contributed greatly to the advance of mineralogy. His discovery of selenium led him to investigate its various compounds, and compare them with the sulphurets. These investigations again resulted in his generalizations on the nature of the sulphur salts, and a new classification of the various salts. Subsequently, he investigated the compounds of fluorine, and arrived at some of the most important and valuable results that have yet been obtained by the analytical chemist.

Whilst Berzelius was writing the first edition of his "Manual of Chemistry," Dalton had promulgated his idea of the atomic constitution of matter, and Davy had made his great discovery of the metallic bases of the alkalies. These directed his attention to the laws of combination. He was led to institute researches, with the most scrupulous care, into the combining proportions of the various elements, giving to each its correct number, and was enabled to obtain results perfectly harmonious with theoretical calculations made on Dalton's laws. He was enabled to extend Dalton's law, that one atom of one body unites with one, two, or three, &c., atoms of another body, and showed that two atoms would unite with three, and with five. He also pointed out the great fact, that two compounds which contain the same electro-negative body, always combine in such proportions, that the electro-negative element of one is a multiple by a whole number of the same element of the other. He not only gave to elementary bodies their combining numbers, but introduced the system of symbols, by which chemical labor has been so greatly facilitated. Till the time of Berzelius, organic chemistry was a waste, with here and there an attempt to explain the phenomena of living beings upon chemical principles,—

and which, from the entire want of experimental foundation, was even worse than useless. The compounds found in plants and animals, were not supposed to come within the category to which the laws of combination applied. Berzelius was the first to show that these laws could be applied to animal and vegetable products; and, in so doing, he opened the way for the discoveries of Mulder, Liebig, Dumas, Boussingault and others.

As a skilful manipulator, Berzelius has had few equals in the history of chemistry. To this we are indebted for the immense variety, number, and success of his analyses. Many of the analytical processes in use at the present time, have had their origin with him.

The personal appearance of Berzelius was that of a strong, healthy man, with nothing in his habits or manners to impress a stranger with a sense of his powers. A chemist who visited him says, "He has nothing of pretence, reserve, or singularity about him; so that his plainness drew from a fellow-traveler of mine, whom he allowed me to introduce to him, the observation, 'I would never have thought him the great man he is said to be.'" His attention to strangers was very great,—especially to those who took an interest in chemistry. With these he would frequently spend hours in his laboratory, explaining his methods of working,—and, on their departure, he left the impression that he was the honored party. He was an early riser, and gave the first part of the day to his most important work, whatever that might be. He seldom either wrote or experimented in the evening, leaving that part of the day for reading and social relaxation. He had no particular times for writing or experimenting; when he had a work to finish, he would write sometimes for months, without performing an experiment,—but if anything of importance occurred to him, during his writing, requiring further investigation, he would at once give up the pen, and work perhaps for weeks in his laboratory. Few men were more beloved in the city of Stockholm than Berzelius.

Were the merits of this great chemist less, we might not be able to afford to hint at any defects. But regarding him at a distance, he appears to us to have carried his caution beyond the requirements of scientific research. His feelings were conservative, and though constantly going forward to the new, he still clung with tenacity to the old. He was almost the last chemist of eminence that admitted Davy's theory of the elementary nature of chlorine. Even after envy and prejudice had given up their opposition, the caution of Berzelius withheld assent. In the recent advances of organic chemistry, also, and more especially in its applications to the physiology of plants and animals, Berzelius has looked on with the eye of a critic, and withheld, to the last, his adhesion to some of the advanced positions of this department of the science. We will allude to his criticisms on his brother chemists, which were sometimes unnecessarily severe, only to add that, in the latter years of his life, he has been heard to say, that he regretted having expressed himself in a way that could have given unnecessary pain to others. Lond. Athenæum, Aug. 1848.

TRANSACTIONS OF THE BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Report on Atmospheric Waves. By Mr. Birt.

The report consists of three parts:—the first having reference to the information we at present possess, relative to such individual waves as have been determined: the second treating of the barometric curves which result from the crossing of the north-westerly and south-westerly waves, the two principal systems common to Europe—the most prominent subject being that particular curve known as the "great symmetrical wave of November:" and the third embodying the results that have been obtained during the last year, illustrative of the symmetry of the "great wave," more particularly the locality of greatest symmetry, and the departure from symmetry in certain directions.

Under the second head, the author has thrown together the result of his inquiries into the *forms* presented by the barometric curves at certain stations, and has devoted attention to the symmetrical curve of November, as it has been observed at the Observatory at Greenwich, in the years 1841 to 1845. In connexion with this subject, the author remarked, "it has been assumed that the symmetrical wave of November consists of *five* subordinate waves, giving rise to the five maxima which characterize it, the central maximum forming the apex of the symmetrical curve, the remainder being subordinate thereto. (Association Reports, 1846, p. 125.)

"Upon a close inspection of the curves of the 'great wave,' as laid down from the Greenwich observations, six subordinate maxima can be traced, three on each side the central apex, which, in all the years, is by far the most prominent. The mean curve leads to the conclusion, that *Greenwich is not the point of greatest symmetry*, its closing portion being depressed more than two inches below the commencement. The next feature is the decided rise of the mercurial column, during a period of sixty-eight hours preceding the transit of the crest; the value of this rise is ·7 inch, or about ·010 inch per hour. The fall is not so precipitous; the barometer appears to be *kept up* in this locality by the *first subordinate maximum* succeeding the crest, so that, at the epoch of sixty-eight hours after transit, the value of the reading is more than two inches higher than at sixty-eight hours before transit. At eighty hours after transit a precipitous fall commences, which continues during the next twenty-four hours, the mercury sinking ·36 inch, or about ·015 per hour. The fall afterwards continues, with two slight interruptions, answering to the subordinate maxima, until the close of the wave, 148 hours after transit."

The peculiar features of the mean curve, especially the difference between the initial and terminal readings, ·241 inch, combined with certain features exhibited by the "great wave," at its last return, has suggested the possibility of expressing numerically the departure from symmetry for any station that may be selected. This departure from symmetry is strikingly manifested by the observations of 1846, especially as we proceed from Brussels, the European nodal point, towards

Ireland and the north-west of Scotland, and is well seen in the series of curves, illustrating the author's report in the last volume of the Association Reports.

Three principal maxima characterize these curves on the 5th, the 9th, and the 12th of November; and the differences of altitude between those of the 5th and 12th, have been employed to indicate the deviation from symmetry in the direction already alluded to. The discussion of these differences, and the results deduced from them, form the third part of the report.

The author has laid down, on a map of the British Isles, these differences, and from them constructed a chart of the lines of equal deviation from symmetry—these lines range from ·100 inch—which passes north-west of the Channel Islands, proceeds towards the Isle of Wight, skirts the shores of Sussex and Kent, and passes through Ramsgate—to ·550 inch, which passes through Limerick, is slightly curved as it crosses Ireland, and proceeds nearly in a straight line across the Scottish Islands, to the north-west of Great Britain. The values of these lines express the *depression* of the maximum of the 5th below that of the 12th. Among these lines, the author regards the direction of that representing ·260 inch as the best determined. It appears to have passed near, and to the west of, Helstone, this station exhibiting a deviation of ·258 inch; it then proceeded along the coasts of Cornwall and Devonshire, crossed the Bristol Channel, entered Wales, and continued its course across Glamorganshire, towards Brecon, which it left to the north-west, as it rather abruptly changed its direction, and proceeded towards Gloucester, which it passed through. It appears to have undergone considerable inflexion, as it traversed the central parts of England, rising again towards Nottingham, which is removed ·025 inch from it to the west; it finally left the shores of England, at the south-eastern angle of Yorkshire, and entered on the German Ocean.

The author solicited attention to a feature which characterizes all these lines, especially the one just traced, viz., the decided inflexion they undergo as they pass over the land.

The chart exhibits *two* systems of inflexion, one being peculiar to Ireland and England; the general direction of the lines undergoing a change as the line of greatest symmetry is approached, the inflection being governed apparently by the masses of land; and the other to Scotland, the inflexion being very decided over the land northward of the Firth of Forth.

From the *single* instance discussed by the author, the result appears to be, that the symmetry of the barometric curve is departed from in a greater degree at *inland* stations; a greater difference between the points selected, being exhibited at such stations than at the sea coast on either side. The report closed with some remarks on the non-persistency of the *direction of these* lines of deviation from symmetry, and on the high probability that they revolve about the nodal point of the two principal systems of atmospheric waves, Brussels.

Lond. Athenæum, Aug. 1848.

On the Advantageous Use made of the Gaseous Escape of the Blast Furnaces of Ystalyfera. By Mr. J. Palmer Budd.

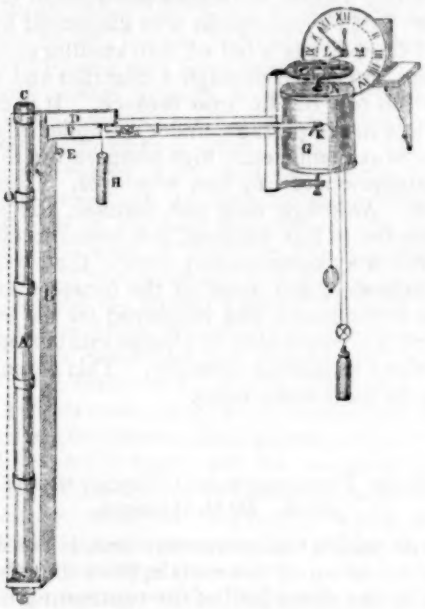
This communication drew attention to an economical application of the heated gases which are usually allowed to escape from the top of the iron furnaces. It appears that the gases which are evolved from these furnaces, escape at a temperature which is about the melting point of brass. In the iron works at Ystalyfera, where the iron is smelted by the use of anthracite coal, advantage has been taken of this in a most ingenious manner. By an arrangement, which is in its character exceedingly simple, but somewhat difficult to describe without a model, (Mr. Budd's description was illustrated by a very nicely constructed one,) the hot gas is led off into another channel, by means of a strong current, generated through a chamber and air-way, from a point just below the top of the iron furnace. It is conducted, very little heat being lost in the passage, under the boiler of a steam engine; and it is found to be at a sufficiently high temperature to heat the boiler, without the consumption of any fuel whatever. Hence an immense saving is effected. Although only one furnace, and one boiler, has hitherto been adapted to this purpose, it is found to effect a saving of £350 a year. We may consequently expect that, when the experiment is further extended, and more of the furnaces so arranged that this heat may be economized, and employed for the numerous useful purposes to which it is applicable in a large establishment, the saving will amount to many thousands annually. This communication is to be printed entire in the Transactions. Ibid.

On a Self-Registering Thermometer, with Twelve Months' Tracings of its Work. By M. Harrison.

The principle on which the instrument acts, is the difference in the expansion and contraction of two metals, from the effects of heat and cold, and acting by the direct pull of the contracting metal, when it is kept in a straight line. It is made sufficiently powerful to overcome any resistance which the fulcrums of the levers, or the tracing pencil, may cause. I have selected cast iron and hard-rolled copper as the best suited for the purpose. I find, from tables published by Smeaton and others, that copper expands $\frac{1}{580}$ of its length, while cast iron only expands $\frac{1}{910}$, with a variation of 180 degrees of Fahrenheit's thermometer, which leaves a difference of about the $\frac{1}{1260}$ of its length; and as the range of the thermometer in the shade, in this climate, is about 90 degrees, or half of 180, I have the $\frac{1}{2520}$ part of the length of the copper bar employed as a moving power. I fixed upon a bar ten feet long, as being a convenient length; the two metals will then vary nearly the one-and-twentieth part of an inch, between the hottest day in summer, and the coldest day in winter. This variation I multiply by means of a compound lever, so as to get a sufficient scale to divide. The end of the last lever carries a pencil, which traces upon a revolving cylinder the variations that take place. In order to divide the scale

accurately, I procured a standard thermometer, by Messrs. Troughton & Simms. I placed it in the same situation, and made several observations in the day, for some weeks, in the spring of the year, when the range of the thermometer is the greatest. After I had got the scale properly divided, I engraved it on a plate of copper, in order to get a number of copies printed. The only attendance the instrument now requires, is to put a fresh paper upon the cylinder, by means of stretching screws fixed on one side of the cylinder, once a week, when I wind the time-piece up.

Self-Registering Thermometer.



A, copper bar, one inch in diameter, and ten feet long; B, cast iron trough, to which the copper bar is made fast at the bottom; C, brass cap, soldered fast to the copper bar, with knife edges on the under side, which rest on the tubular end of the first lever D, its fulcrum rests on the upper end of the cast iron trough B; E, flanges to bolt the trough to the outer side of a wall, near the angle of a room; F, part of the cast iron trough which passes through the wall into the room, carrying the fulcrum of the second lever I, and to which the revolving cylinder G is fixed; H, a weight to keep the first lever D steady on its bearings, and to counterpoise the second lever I; K, tracing pencil; L, a screw working in the edge of the wheel M, and coupled to the minute hand of the time-piece, making one revolution in an hour; the wheel M is fixed to the axis of the cylinder, and has 192 threads cut in its edge, and would make one revolution in eight days; N, a binding screw, to adjust the pencil to the proper hour line, when a fresh paper is put on

once a week; O, brass rings, made fast to the cast iron trough, to keep the copper bar steady, but through which it can move; the dotted line shows the side of the iron trough.

The instrument acts by the difference in the expansion of copper and iron, that difference being multiplied about 120 times, by a compound lever. The scale was obtained by placing in the same situation a standard thermometer, by Messrs. Troughton & Simms, for several weeks, in the spring of the year, when the range is the greatest, and making a great number of observations each day.

Tabulated results for the year 1847, *taken from tracings by the Instrument described.*

General mean of the whole year, . .	47·89
" of January, . . .	36·61
" of April, . . .	44·13
" of July, ...	61·80
" of October, . . .	49·35
Highest single observation, 1st August, . .	80·00
Lowest single observation, 13th February, .	22·00

Prof. Lloyd observed, that he much feared, as the indications of this thermometer were derived from the unequal expansion of different metals, magnified by a system of levers, that the bearings of the levers would be found not to move continuously, but by starts.

Sir W. S. Harris thought it likely some correction would be required for the hygrometrical state of the paper on which the curves were traced, as well as for the effects of changes of temperature of other parts of the instrument.

Prof. Lloyd, having been requested, by several members, to describe a barometer on a new principle which he had lately seen, said that it was a French invention. A cylinder of copper, with a very thin and corrugated end, was partially exhausted and hermetically sealed; and the effect of the varying pressure of the atmosphere, on the thin end, was magnified by a system of levers, so as to affect the index of a dial, very little larger than a watch dial. A friend of his had tested the indications of the instrument, by placing it under the receiver of an air pump, and observing its march, in comparison with the indications of the long gauge, and found them to agree to less than the 1-100th of an inch.

Mr. Jenkins mentioned some remarkable cases of the discrepancy of the indications of a number of compared thermometers, ranged along a wall at short distances, and at intervals of a quarter of an hour.

Ibid.

On some New Relations of the Diamagnetic Force. By Prof. Plücker.

Mr. Plücker gave a short account of experiments belonging to a new magnetic action. A crystal with one optical axis, being brought between the two poles of a magnet, there will be a repulsive force, going out from each of the poles, and acting upon the optical axis. According to this action, the crystal, if suspended, will take such a position, that its optical axis is placed within the equatorial plane. When the

crystal has two optical axes, there will be the same action on both; according to which, the line bisecting the acute angle formed by the axis will turn into the equatorial plane. When the crystal is suspended in such a way, that it may freely move round any line whatever of the plane, containing both axes, this plane will take the equatorial position. Thus a crystal, being neither transparent, nor showing any trace of its crystaline structure, we may, by means of a magnet, find the optical axes. At the same time we get a new proof of the connexion between light and magnetism. When light is passing through a crystal, there are in general two directions, where it is effected in a quite distinct way,—these same directions are acted upon by a magnet.

Prof. Faraday contrived to convert two raw potatoes into representatives of the poles of an electro-magnet, and, by a slice of another, with a quill stuck through it, represented the magnetic or diamagnetic crystal with its optic axes—and thus contrived to convey a distinct idea of the exact results of Prof. Plücker's discoveries of the relations of the optical axes of the magnetic and diamagnetic crystals, and the changes of distance, to the nature and laws of the attractions and repulsions exhibited under the several circumstances detailed.

Sir W. S. Harris considered that the laws of magnetic forces, in relation to the action of magnets on each other, or a magnet on a mass of common iron, were liable to vary, from the changes which arose in the amount of inductive action of which the attracting bodies were susceptible. He had shown, in a paper in the *Edinburgh and London Philosophical Transactions*, that, in electricity and magnetism, the amount of inductive disturbance was limited,—so that, after a certain time, under given conditions, the disturbance became the greatest possible, and then the law of the force changed; and hence arose all the irregularities which had embarrassed early inquirers into the subject. In fact, the force between a magnet and a simple mass of iron varied in a simple inverse ratio with the force induced in the iron, and with the disturbance conjointly. If either of them became constant, the whole force varied with the other. If, therefore, it should happen that, as the disturbance in the iron approached a limit, the changes were not uniform, then we obtained irregular results. So long, however, as the induced force went on uniformly, we had the total or absolute force in the inverse ratio of the squares of the distances. In the case of two magnets magnetized, or nearly so, the force of attraction between them varied in the inverse ratio of the simple disturbance, because the amount of the induced force had been reached. On this principle it was found, that in the repulsive force between the two magnets, the repulsive action at certain distances became changed into attraction; and it is not an uncommon circumstance, to find two magnets attract at one distance, and repel at another.—These results, he thought, might be applied in explanation of some of the phenomena now under consideration. The force of magnetic action might vary, whilst the diamagnetic force, after all, may have been constant.

Dr. Lloyd inquired if Prof. Plücker had tried whether crystals with

positive axes, exhibited any difference in the laws of diamagnetic action, from those which had negative axes?

Prof. Faraday replied, that Prof. Plücker had minutely investigated this point, and found no diversity of law corresponding to this difference in optical structure.

Sir D. Brewster inquired whether Prof. Plücker had investigated the influence which changes of temperature produced in the diamagnetic action of crystals? Some of these changes, he conceived, were of such a nature as to afford an admirable test, whether the same circumstances in the corpuscular constitution of the crystal, on which their optical characters depended, were those which gave rise to their diamagnetic relations, or not. For example, in some of the biaxal crystals, as sulphate of lime, when heated, the axes approached, and at length coincided,—the crystal becoming monaxal; and by continuing the heating, they again separated in a plane at right angles to the one in which they before lay. Such a series of changes, he conceived, if examined in relation to the diamagnetic forces, might afford a test whether the curious properties discovered by Prof. Plücker, had their origin in the chemical constitution of the bodies, or in that corpuscular structure from which their optical properties originated.

Prof. Plücker replied, that he had not tried the class of experiments pointed out by Sir D. Brewster; but he admitted their importance, and expressed a determination to pursue the inquiry.

Prof. Grove inquired whether the experiments were tried with the crystals placed in vacuo?

Prof. Plücker replied no; but in every case they were suspended either in air or in water.

Prof. Grove pointed out the necessity of caution in that case, as it was well known that differences between the diamagnetic actions of suspended bodies, and of the surrounding medium, would sometimes mask, and even reverse the action.

Prof. Faraday pointed out the precautions which had been taken to avoid this source of error. Ibid.

On the Submergence of Ancient Land in Wales; the Accumulation of newer Strata around and above it; and the Re-appearance of the same Land by Elevation and Denudation. By Prof. A. C. Ramsay.

This communication was illustrated by a section, on a true scale, of the rocks near Builth, in Radnorshire, where the Wenlock shales rest unconformably on the Llandeilo flags. The lower rocks must have been elevated previously to the formation of the upper, and their upturned edges must have been worn away by the sea, when the upper rocks were deposited, or previously. No power is known to exist far below the level of the sea, by which this process could have been effected; it must have taken place at the sea's level.

Throughout Wales, the Lower Silurian rocks appear to have been disturbed at one particular period—to have been heaved above water, and formed a coast, around which the succeeding rocks were accumu-

lated. Near Bishop's Castle, the upheaval of the Llandeilo flags was followed by the deposition of the Caradoc sandstone, which is full of pebbles of the older rocks. After this, a subsidence appears to have taken place, the area of the sea was increased, and the Wenlock shale was deposited, not only over the Caradoc sandstone, but beyond it, as at Builth, upon the Llandeilo flags; and in some places the shale rests on Greenstone rocks, and certain pebbles from it, being in fact a gravelly sea bottom. This depression of the bed of the sea continued also during the deposition of the Ludlow rocks, which are conformable to the Wenlock shale; and there is no marked alteration in the organic remains of the two rocks. The Wenlock shale is 1500 feet thick, and the Ludlow rocks 3500 feet; and as it is certain that their organic remains could not have existed at the depth of 5000 feet, we must suppose a gradual subsidence of the area, such as is believed to be now taking place amongst some of the coral islands, until 5000 feet of rocks was accumulated over what had been dry land.

The old red sandstone, which has a maximum thickness of 8000 feet, appears also to have extended over this country, judging by the outliers, at a considerable distance to the north and west. Subsequently, the whole of this series, from the Caradoc sandstone upwards, was removed, and the ancient Silurian strata became the surface of dry land, as they had been so long before.

It now became a question, what amount of alteration may the Silurian rocks have undergone, during the time they were so covered up? If the same laws regulated the ascent of the internal temperature as at present, namely, 1° for every 54 feet, then the addition of 5000 feet of rock would have raised the temperature by 92°, whilst 9000 feet would have added 160°, and with 11,000 feet of superincumbent strata, the Lower Silurian rocks must have endured an increased temperature of 212°. To influences of this kind may, perhaps, be attributed the crystaline or metamorphic condition of some of the more ancient rocks,—as suggested by Sir J. Herschel, in a paper communicated years ago to the Geological Society of London.

The Dean of Westminster referred to the Portland rock, in which a bed of vegetable soil occurs, full of trunks of trees, and cycadites; this bed rests on limestone containing ammonites, and is covered by similar marine deposits. Again in the Weald, fossil forests, and beds of freshwater shells are found above marine accumulations, and followed by the greensand and chalk. At the present time we find peat, and antlers of the red deer, in the bed of the channel, several miles off Swansea. On the Norfolk coast, and in the English Channel, are found the bones of the elephant, and fossil wood, disinterred from former cliffs by the action of the sea. These, with many other circumstances, were quoted as showing that, whilst the sea-level was fixed, the land had suffered depressions and elevations at many periods of time.

Prof. Phillips pointed out the extent of some of these subsidences of the land; for example, the old red sandstone, 8000 feet thick, all formed in shallow water, and the coal measures 11,000 feet thick, and added under similar circumstances; and inquired what condition of the interior of the earth can have admitted of the gradual subsidence of such great masses of strata? According to Mr. Hopkins's statement,

it was improbable that the interior would *now* admit of it. With respect to the augmentation of temperature which would follow on the addition of several thousand feet of strata, it should be remembered that the communication of heat from below, through such rocks, was remarkably slow; and the law of the distribution of internal temperature could not be assumed the same in ancient as in modern times.—As to the level of the sea remaining unchanged, this was only assumed for security in geological reasoning; there was evidence in the Malverns of a sea-level 600 feet above the present, but it was impossible to say whether that ancient level was nearer the *centre of the earth* when formed than now.

Lieut. Col. Portlock communicated some observations on apparent changes in the level of the coast near Portsmouth, and contended that, as these evidences of subsidence could be traced back to the most ancient times, so they had continued up to the present day, and expressed his conviction that a parallel might be found in existing nature to all the phenomena of ancient times. It appears that Fort Cumberland, near Portsmouth, stands on a bank of gravel and sand, and that, owing to some new wall made to protect it from the sea, a fresh direction was given to the tide, and a portion of the bank undermined and washed away, in the course of which a thick plank with a bolt was discovered, showing that the basis of the fort had no great antiquity. An artesian well has also been made to supply Blockhouse Fort, which shows, for the first 60 feet, nothing but clean shingle, and then a layer of sandy clay, full of common oyster shells.

Prof. Oldham exhibited a section of the hills known as the Chain of Kildare, in Ireland,—a low range, running N. E. and S. W., amidst bogs and flat country. They consist of a great mass of trap, succeeded by alternating slates, sandstones, and trap, calcareous rocks, shales, slates and sandstones,—all forming one conformable and regular series, elevated at an angle of from 45° to 70°. Resting on the edges of these rocks, and filling up the hollows, is the conglomerate of the old red sandstone, succeeded by the carboniferous limestone. On the flanks of the hills, and rising nearly to their summits, is a great deposit of modern drift, attaining a thickness of 200 feet in sheltered places. The section afforded evidence of several periods of elevation above, and depression beneath, the level of the sea; and it was alleged to be an object with the geologist, to map the surface of the land at each period of the earth's history.

Prof. Ramsay remarked, that he had not intended to imply that the level of the sea remained absolutely the same, as every deposit in it must raise its level; but he wished to protest against the doctrine, that the ancient sea-beds and beaches, high above the sea, in South America, and elsewhere, had attained their altitude through any subsidence of the sea, instead of the elevation of the land.

Mr. Greenough contended that the level of every sea, and of the ocean, was constantly undergoing changes.

Mr. Benson alluded to the occurrence of ripple-marked sandstones, in the Pennant grits of South Wales, which indicated a subsidence of those beds from near the sea level, to a depth, in some places, of 2000 feet. Ibid.

On the Peculiar Cooling Effects of Hydrogen and its Compounds, in Cases of Voltaic Ignition. *By* W. R. Grove, Esq.

This communication was illustrated by an experiment, in which it was shown that a platina wire, rendered incandescent by a voltaic current, was cooled far below the point of incandescence when immersed in an atmosphere of hydrogen gas. This remarkable cooling property of hydrogen, of course, became the subject of experimental examination, in comparison with other gaseous media. By a very ingenious arrangement, tubes, containing coils of platina wire, were filled with hydrogen and other gases, and then being plunged into water in which delicate thermometers were placed, the wires were traversed by the same current from the battery, and it was found that the water was always more heated in a given time, by the wire in the tubes of oxygen, nitrogen, carbonic acid, carburetted hydrogen, &c., than by that in the tube containing pure hydrogen. It became necessary now, to ascertain the cause of this peculiar phenomenon of hydrogen. It was found not to be due to specific heat, nor to the conducting powers of the gases. Convection did not explain the fact; and considerable difficulty was found, upon examination, to exist, if it was attempted to refer it to the greater mobility of the particles of hydrogen gas, the lightest known, than of either oxygen, nitrogen, or carbonic acid. It was found that this peculiar property also belonged, but to a less extent, to all the compounds of hydrogen and carbon.

A discussion followed, in which Dr. Williams, Col. York, Prof. Graham, and Mr. Hunt joined.

Prof. Graham mentioned the curious fact, observed by him in his researches on the diffusion of gases, that the hydro-carbons move through tubes with great velocity, and that ether vapor, which is four times the density of hydrogen, moves, notwithstanding its weight, at four times the rate of other gases. It was thought this would, perhaps, serve to indicate the path in which an explanation might be looked for.

Mr. Hunt drew attention to the fact, observed by Prof. Graham, that ether vapor had the power of preventing the combustion of phosphuretted hydrogen and of destroying the luminosity of phosphorus, and thought the phenomenon observed by Mr. Grove, connected itself, in some way, with these curious properties of the hydro-carbons. Ibid.

On the Action of the Red, Orange, and Yellow Rays, upon Iodized and Bromo-Iodized Silver Plates, after they have been affected by Daylight, and other Phenomena of Photography. *By* M. Claudet.

It was shown by MM. E. Becquerel and Gaudin, that a photographic image on a Daguerreotype plate, might be developed by the action of the light which permeates yellow and red glasses, without the aid of mercurial vapor. M. Claudet has been continuing his researches on this point, and he confirms those results in a very striking manner. Numerous specimens were exhibited, in which it was shown that the

powers of the so-called *continuating rays*, in developing the image, were not much inferior to the mercurial vapor—presenting a positive image like it, but differing from it in the tint by which it is suffused. M. Claudet suspects that this result is owing to the decomposition of the iodide and bromo-iodide of silver, by the least refrangible rays—and that the whites are represented by finely-divided silver in the place of mercury. The rate of action, when the chemical agency permeates these colored media, is infinitely reduced for these preparations; but still it is evident, that some of the photographic principle permeates them—and also, that these rays which correspond in color with those media, have a peculiar scale of action of their own. Ibid.

On the Influence of Light in Preventing Chemical Action. By Mr. R. Hunt.

Bearing on the same subject as that brought forward by M. Claudet, although differing, inasmuch as one set of experiments were made upon iodized silver plates, and the other upon iodized photographic paper, this subject was taken by the Section, before any discussion was allowed on the preceding communication. Mr. Hunt having called attention to several experiments, in which certain luminous rays had been found to protect photographic agents from chemical change, —particularly in the researches of Sir John Herschel,—proceeded to describe his own experimental investigation of this subject. Taking a piece of highly sensitive photographic paper, which would blacken in a few seconds by the light of an argand gas burner, he threw upon it a condensed spectrum, which had been previously analyzed by a peculiar yellow medium—and then, by means of a mirror, reflected the strong light of the sun upon the paper. It was, therefore, under the influence of the unaltered reflected radiations—and also of the spectrum, from which the chemical agency had been, as nearly as possible, separated. The result was, that the paper was blackened over every part, except that portion upon which the strong line of spectral light fell, which was protected from change, *and preserved as a white band* in the midst of the darkened paper. This experiment was thought, by the author, strongly confirmatory of the view which he had taken, that actinism, or the chemical principle, and light, so far from being identical, are opposed in action to each other. Ibid.

On the Effect of the Rapid Motion of the Observer on Sound. By Mr. Scott Russell.

Until the existence of the very high velocities now given to railway trains, no opportunities have existed of observing any phenomena, in which the velocity of the observer has been sufficient to affect the character of sounds. The author, having had occasion to make observations on railway trains moving at high velocities, has been led to notice some very curious effects in sounds heard at 50 and 60 miles an hour. These effects are not heard by an observer who is stationary.